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A TREATISE

ON

THE PRINCIPLES AND PRACTICE

OF

OPHTHALMIC MEDICINE AND SURGERY.

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ON

THE PRINCIPLES AND PRACTICE

OF

PHTHALMIC MEDICINE AND SURGERY.

BY

T. WHARTON JONES, F.R.S.,

PROFESSOR OF OPHTHALMIC MEDICINE AND SURGERY IN UNIVERSITY COLLEGE,
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TO

THE THIRD EDITION.

In preparing this new edition of my work on the Principles and Practice of Ophthalmic Medicine and Surgery, I have endeavoured to make it as complete an exposition as possible of the subject in its present advanced state. The volume, therefore, has increased so much in size under my hands, that now, with the proof of the last sheet before me, I find that it has run to half as many pages again as the last edition, with a proportionate increase in the number of engravings, both plain and coloured.

I have availed myself, in numerous instances, of the annotations of Dr. Foucher, the able editor of the French translation of the work, so correctly made by Dr. P. Pichot (Paris, 1862); and also of those of Dr. Atlee, contained in the third American edition (Philadelphia, 1863).

In the chapter on the Adjustment of the Sight and Use of Spectacles, Dr. Donders' recently published researches on the subject are fully considered.

In conclusion, I have to observe, that Dr. Liebreich having placed the figures of his magnificent Atlas der Ophthalmoscopie at my disposal, I have availed myself of his kindness by reproducing several of them, and have only to regret that the limits of my Treatise have precluded the reproduction of more.

T. WHARTON JONES.

35, George Street, Hanover Square, W.
London, *October* 3*rd*, 1865.

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TO

THE SECOND EDITION.

"To produce a Work on the Diseases of the Eye, which should serve at once as a text book for students and as a book of reference for practitioners, has been the great aim of the Author in composing this Manual. Accordingly, besides carefully discussing the principles, he has laboured to give such a practical exposition of the subject as will be found available at the bedside of the patient, and in the operating room."

Believing that in the aim here expressed, the Author has not been unsuccessful, he has continued to hold it in view in the preparation of this Second Edition. The additions and alterations made, he hopes, will be all found to manifest a practical tendency, and to bring the Work up to the present state of knowledge in the important department of Medicine and Surgery of which it treats.

35, George Street,
Hanover Square, London.

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ERRATA.

Page 92, for "Fig. 21," read "Fig. 23."

Page 461, tenth line from top, for "pupilliary," read "pupillary."

Page 527, foot note, third line from bottom, for "and was the," read "and was among the."

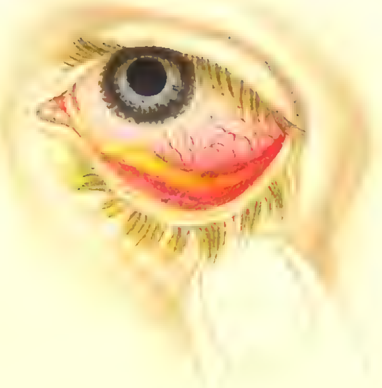
EXPLANATION OF THE PLATES.

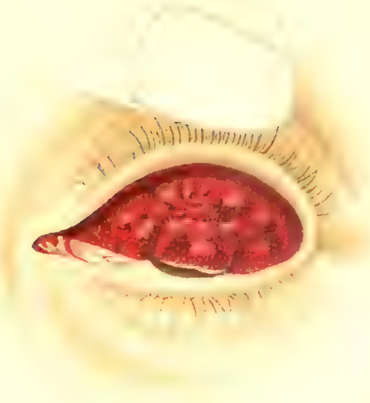
PLATE I.

Figure 1.—This represents catarrhal inflammation of the conjunctiva, as described at pp. 105 and 158 ; and also the mode of examining the conjunctival surface of the lower eyelid, as described at p. 9.

Figure 2.—A well-developed granular state of the conjunctiva of the upper eyelid in Egyptian ophthalmia, as described at pp. 107, 165, and 258. The enlarged papillæ are separated into groups by furrows or fissures. The figure also illustrates the mode of examining the conjunctival surface of the upper eyelid, as described at p. 10.

Figure 3.—A case of phlyctenular, or scrofulous ophthalmia, in which there is a burst phlyctenula on the cornea, with a fasciculus of vessels running from the conjunctiva into it, as described at p. 191. This figure also illustrates the mode of examining the eye in such cases, which occur in children, and in which there is great intolerance of light, as described at p. 17.





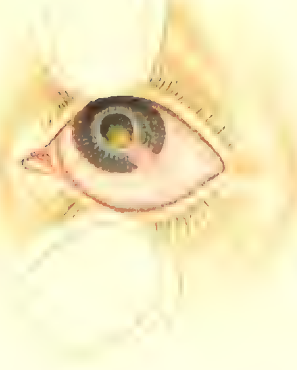


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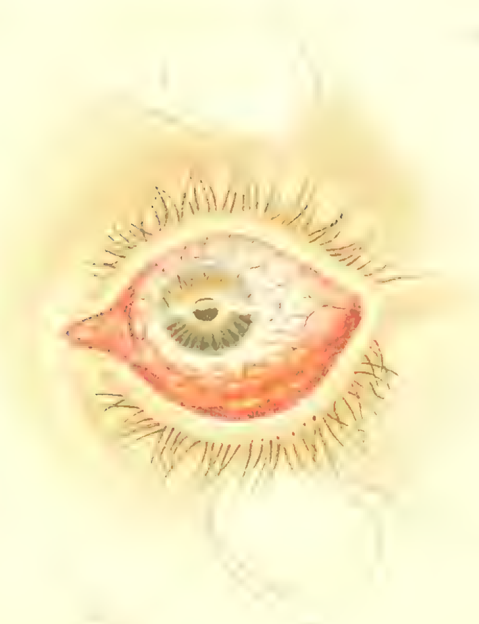
PLATE II.

Figure 1.—This represents a case of granular conjunctiva with pannus. The lower eyelid is held everted to show the vesicular granulations just within its border, and also on the conjunctiva of the lower palpebral sinus. The upper lid is slightly elevated to allow the upper part of the cornea, which is the seat of the pannus, to be fully seen. See pp. 107, 258—260.

Figure 2.—A case of acute parenchymatous corneitis in which, with considerable redness of the white of the eye, there is exudation of lymph and development of new vessels in the proper substance of the cornea. In this case, the cornea presents the peculiar opalescent appearance. See p. 197.



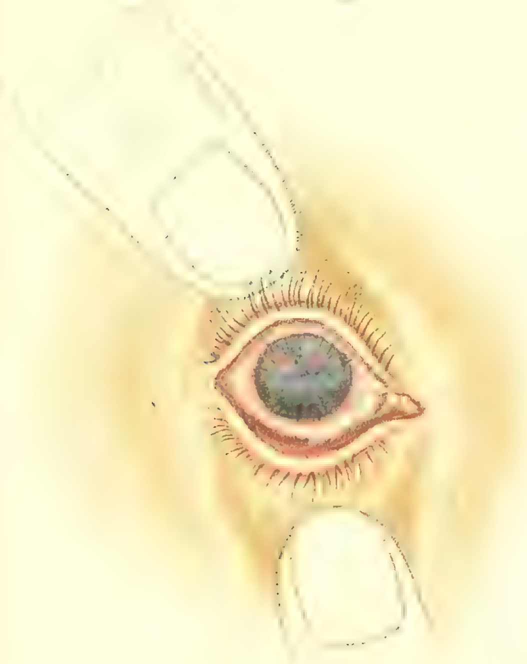
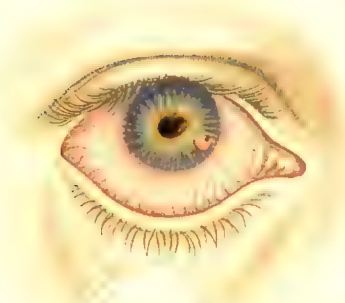


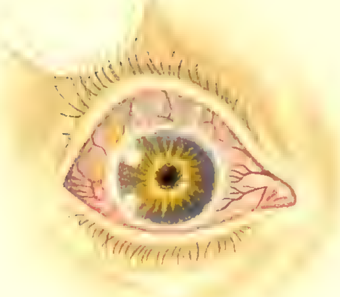
PLATE III.

Figure 1.—This figure represents a case of iritis, as above described at pp. 121 et seq. ; and also illustrates the mode of depressing the lower eyelid for examination of the front of the eyeball. See p. 16.

Figure 2.—Inflammation of the ciliary body and corresponding part of the sclerotica (*sclerotico-kyklitis*), with secondary iritis. Near the outer margin of the cornea, the sclerotica is thickened and yellowish looking ; elsewhere it is purplish. There are two spots of opacity of the cornea at its outer edge. See p. 229.

Figure 3.—Arthritic posterior internal ophthalmia, as described at pp. 241 et seq. The figure also illustrates the mode of raising the upper eyelid for examination of the front of the eyeball. See p. 16.





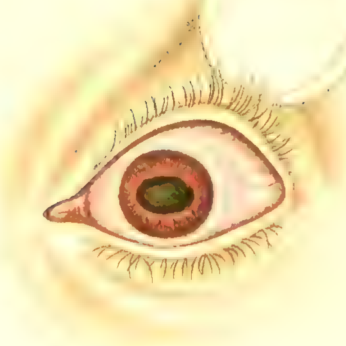
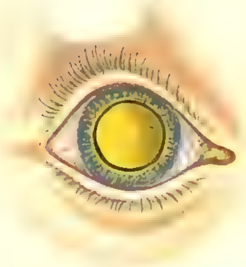


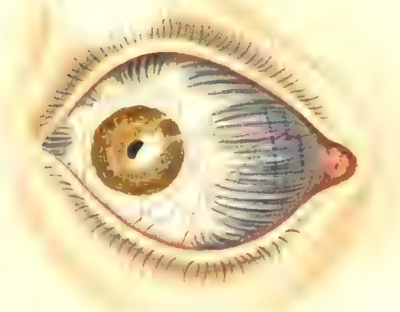
PLATE IV.

Figure 1.—This represents a case of medullary fungus of the eyeball in its second stage, as described at pp. 323 et seq.

Figure 2.—A case of sclerotico-choroid staphyloma from traumatic inflammation of the eye. In this figure there is a good representation of tortuous and varicose vessels. See pp. 237, 280, et seq.

Figure 3.—A case of melanosis of the eyeball, in which the iris has been detached at one part of its circumference, and the black mass is making its appearance from behind, as also through the sclerotica near the cornea. See p. 332.





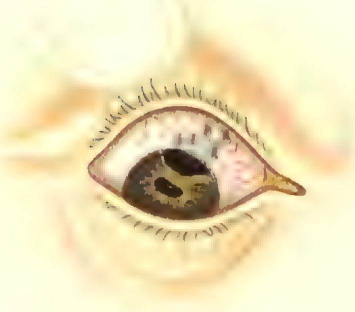
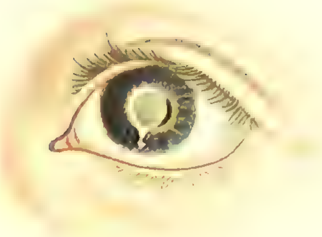


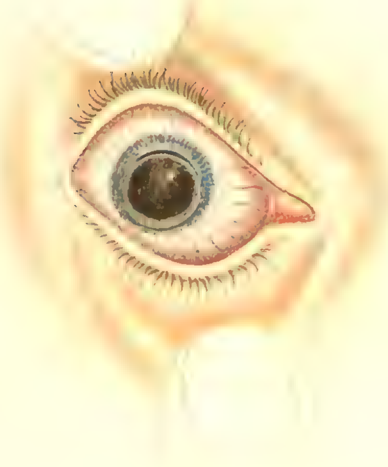
PLATE V.

Figure 1.—The second case of hydatid in the anterior chamber, referred to at p. 315. The body and head of the animal are protruded from the tail vesicle.

Figure 2.—Represents a case of dislocation of the lens into the anterior chamber, the lens being still clear; see p. 750. This figure also illustrates the mode of fully exposing the front of the eyeball for examination, as above described at p. 16.

Figure 3.—Represents the third case of cyst, in connexion with the iris, above described at p. 319.





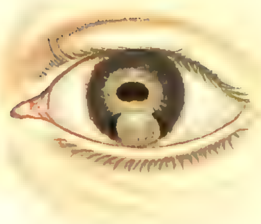


PLATE VI.

This (which is a reproduction of Figure 1, Table IV., of Liebreich's Atlas der Ophthalmoscopie) represents the ophthalmoscopic appearance (inverted image) in a case of *exudative choroiditis* (p. 235). There is seen copious exudation both on the inner surface and in the substance of the choroid.

The large whitish spot represents exuded matter on the inner surface of the choroid.

The small clear round spots in the neighbourhood of the optic nerve are nodules of exudation in the interstices of the choroid.

After the absorption of such nodules the choroidal tissue is left atrophic and destitute of pigment.

A peculiarity in the pathological anatomy of the choroid, here seen, is, that at the places where the membrane has become atrophic the *margin* is almost always the seat of increased pigment deposit. See p. 126.

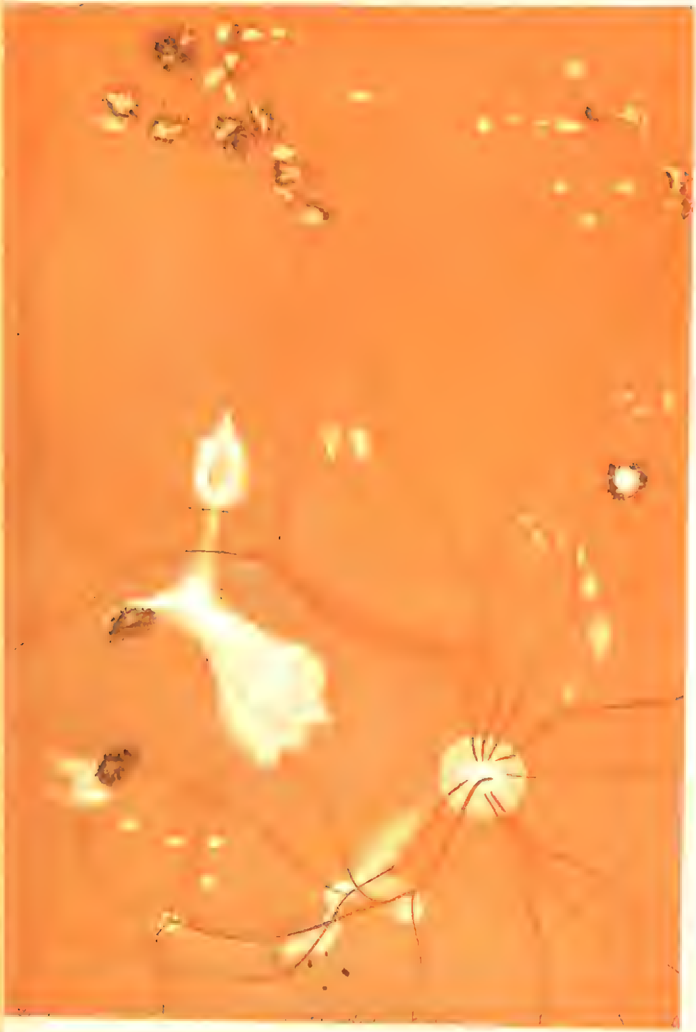


PLATE VII.

This is a reproduction of Figure 1, Table X., of Liebreich's Atlas, representing the ophthalmoscopic appearance (inverted image) in a case of syphilitic retinitis.

Opacity of the retina extends from the papilla, the sharp contours of which have disappeared, in the direction of the larger vessels, around the macula lutea and towards the periphery, where it disappears.

In such cases the light is not reflected from the opaque exudations so strongly, as it is by the shining white patches of fatty degeneration of the retina in Bright's disease, fig. 18, p. 56.

In the upper part of the figure is seen the filmy diffused opacity pathognomonic of retinitis.

The veins proceeding upwards (inverted image), are much dilated and tortuous, whilst those proceeding downwards are very slender and partially obliterated.

On the inner surface of the retina there are, in the lower part of the figure, radiating opaque-white deposits of lymph, which bury and compress a fasciculus of vessels so much that some of their ramifications when they reappear are reduced to fine white lines.

There are numerous patches of ecchymosis, both recent and old, some behind, some on the inner surface, and some in the substance, of the retina.

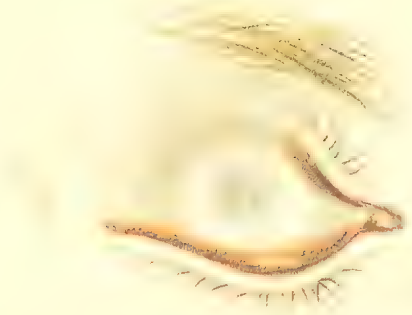
The large clear irregular-shaped patch with pigment-deposit on one side at the lower part of the figure, is a manifestation of accompanying choroidal inflammatory degeneration.

In ordinary cases of syphilitic retinitis, the state of the veins is not so much altered; nor are there such copious exudation of lymph, so much extravasation of blood, and such extensive degeneration of the choroid, as are seen in the lower part of the figure. See p. 127.

PLATE VIII.

Figure 1 represents the state of the eye for which the operation of transplanting a flap of skin according to the Italian or Taliacotian method, described at pp. 634 et seq., was undertaken.

Figure 2 represents the eye as it now appears, five years after the operation. This figure has been engraved from a photograph.



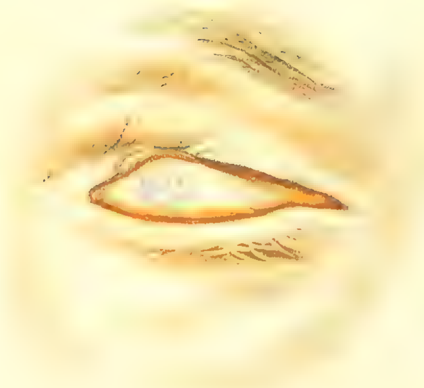
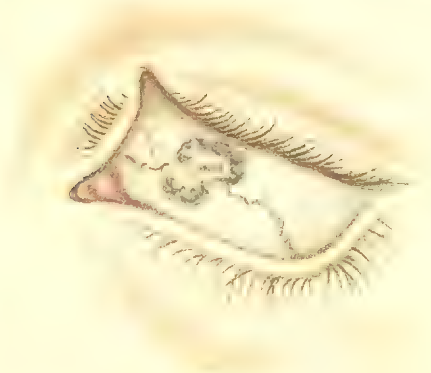


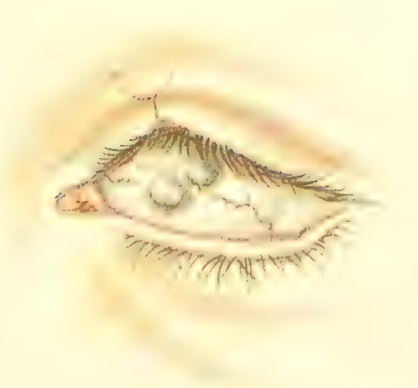
PLATE IX.

Figure 1 represents an eye affected with traumatic *coloboma palpebræ et lagophthalmos* on which the operation described at pp. 662 et seq., was performed.

Figure 2 represents the eye after the operation.

Figure 3 represents the same when an artificial eye had been fitted in.





THE

PRINCIPLES AND PRACTICE

OF

OPHTHALMIC MEDICINE AND SURGERY.

CHAPTER I.

GENERAL CONSIDERATIONS ON THE DIAGNOSIS AND TREATMENT OF THE DISEASES OF THE EYES.

SECTION I.—OPHTHALMOSCOPY, OR EXPLORATION OF THE EYES IN ORDER TO A DIAGNOSIS.

In exploring the eyes for the purpose of establishing a diagnosis, attention has to be directed, on the one hand, to such material changes in the constitution of those organs as the surgeon himself can directly see or touch, or, at least, infer from cognizable marks or symptoms;—and, on the other hand, to the disturbance of sight, pain, and other morbid sensations in the affected organs, regarding which the patient himself can alone furnish explicit information—though even on this head, the surgeon may also infer something from his own observation.

The first of these two kinds of exploration is called *objective;* the second, *subjective.*

§ 1. OBJECTIVE EXPLORATION OF THE EYES.

At first the eyes should be viewed merely, *not touched.* This precaution it is important to observe, especially in inflammations, in order to avoid causing an increased determination of blood, lacrymation, &c., which, in such cases, are liable to be occasioned by the slightest touch, and which, by complicating the appearance natural to the inflammation, might give an erroneous view of the nature of the case. In an hospital, the pupils should not, on any account, be permitted to touch the eyes of a patient, before the surgeon has made his examination.

The surgeon should, in succession, glance at the eyebrows and orbital margins, the eyelids and their movements, the borders of the eyelids and state of the eyelashes, and the corners of the eyes, noting the presence or absence of lacrymation. He should then pass in review the form and appearance of the eyeballs generally—their size and degree of prominence—movements and direction—the correspondence of their axes—the appearance and colour of the white of the eye—the aspect of the cornea—the colour of the iris—and the state of the pupil.

The general bearing of the patient, and the expression of his features, should not be left unobserved. The information thus obtained will sometimes reveal the nature of the case, or will guide in the further exploration of it. By the general bearing of the patient, and the expression of his features, it will be seen, for example, if he is affected with intolerance of light—if he be blind from amaurosis, or blind from cataract.

The patient, intolerant of light, keeps his head bent down, and covers his eyes with his hands, in order to protect them from the light. The eyelids are spasmodically closed, and at the same time the eyebrows are knit and depressed, and the cheeks drawn up, so that the whole features are much distorted; whilst there is greater or less lacrymation.

The confirmedly amaurotic patient steps forward with an air of uncertainty, his head thrown back, and the eyes wide open—not converged and fixed on any object, but staring forward as if on vacancy—perhaps moving about in an oscillating manner, or squinting; the cataractous patient, on the other hand, is more steady in his gait, and with his head bent downwards and to one side, his eyes shaded with his hand or half-closed, he moves and directs the eyes naturally and steadily, in an exploratory manner.

This survey, constituting the first step in the objective exploration of the eyes, may be taken during the time the patient is coming into the room, and relating the history of his case. In the subsequent steps of the objective exploration, attention should be carefully directed to the relations which may exist between the appearances observed and the patient's sensations—pain, tolerance or intolerance of light, and state of vision as elicited in the subjective exploration.

Most probably the general objective survey, now indicated, in conjunction with the subjective examination, to be spoken of by-and-by, will direct the practitioner to the seat of the disease. On this part he will accordingly fix his attention, and subject it to the detailed scrutiny necessary to enable him to discriminate exactly the nature of the case.

The account of the mode of conducting the objective exploration of the different parts of the eye in detail, to which I now proceed, will necessarily include references to the principal morbid conditions of the organ—in fact, will constitute an epitome of the pathology of the eye.

1st. *Exploration of the eyebrows and orbital margins.*

The affections of the eyebrows and orbital margins do not require much exploration for their diagnosis; a glance and a few touches being in general sufficient, except in the case of a fistulous opening at the margin of the orbit, when it may be necessary to introduce a probe to ascertain the extent and direction of the fistula, and state of the bone.

The skin forming the boundary of the inner canthus of the left eye of a man who had had syphilis about two years before, was the seat of what appeared a small ulcer covered with sloughy-looking matter. On probing this, the instrument could be passed on to some depth, and by directing its point downwards, it entered the nose.

In injuries and affections of the eyebrow and orbital margins, the eyelids are almost necessarily more or less implicated; and it is to be remarked, that in the case of blows, contusions and wounds of the eyebrow and margin of the orbit, there may have occurred extravasation of blood in the interior of the eye, laceration of the internal tunics, injury of the fifth pair, concussion of the retina, or even of the brain, and, as a consequence, amaurosis. A man presented himself at the hospital with his right eye bound up. On examination there was found a slight wound of the lower eyelid, and some swelling of both. Besides this, however, paralysis of the facial, abducens, and oculo-motor nerves was detected, and on inquiry it was ascertained that the patient had fallen from a tree on the upper and left side of his head a week before. The man was at once put to bed; but in the course of two days tetanus came on, and he died three days after.

In the exploration, attention is directed to the state of the skin all round the margin of the orbit, and of the hairs of the eyebrow. The skin may be the seat of an eruption, or of cicatrices. The hairs may have fallen off, or they may be the seat of phtheiriasis. Tumours will not unfrequently come under notice in the eyebrows, or connected with the margin of the orbit. Those presenting themselves at the margin of the orbit have sometimes their origin in that cavity or in a neighbouring one. Such tumours may be phlegmonous, osseous, fatty, encysted, fibrous, cancerous. Foreign bodies also may present themselves here. The injuries met with are burns, from which the eyelids in general suffer most; contusions and wounds with ecchymosis.

The affections found more particularly seated at the margin of the orbit, besides fracture, &c., which may complicate the injuries just referred to, are inflammation and abscess, involving the periosteum and bone. Abscess manifests itself by a swelling, dark red at first, subsequently yellowish. Having burst or been opened, the carious or necrosed bone is felt bare and rough, on the introduction of a probe through the opening, now become fistulous. Lastly, the margin of the orbit may be thickened from periostosis, or hyperostosis, or be the seat of an exostosis, or of an osteo-sarcomatous tumour.

2nd. *Exploration of the eyelids, and their tarsal border, including the state of the cilia and Meibomian apertures.*

The points to be noticed in regard to the eyelids, are:—first, their position, their connections, and their movements; then their organic condition generally, and that of their tarsal border in particular; the direction of the eyelashes, the state of the Meibomian apertures, and of the Meibomian discharge, as indicated by the presence or absence of incrustation of the eyelashes.

The morbid changes in position, which the eyelids may be found to present, are *eversion* or *ectropium*, *inversion* or *entropium*, *retraction* and *shortening* or *lagophthalmus*. The morbid connections are, adhesion to each other's edges, or *anchyloblepharon*, which may be either mediate or immediate, total or partial, congenital or accidental; and adhesion of the inner surface of one or both eyelids to the globe, or *symblepharon*, which may likewise be mediate or immediate, total or partial.

In proceeding to indicate the morbid changes to which the movements of the eyelids are subject, it may be useful to premise that it is chiefly by the movements of the upper eyelid that the open or closed state of the eye is produced. The upper eyelid is both vertically and horizontally larger than the lower, and in the closed state during sleep covers much more of the front of the eyeball; but in voluntary or forced closure of the eye, the lower eyelid is drawn up, being at the same time impressed with a horizontal movement towards the inner angle by the action of the orbicularis palpebrarum muscle, and meets the upper lid half-way. Or, if the upper lid be immovably retracted under the edge of the orbit, either by disease, or by the finger for the sake of experiment, the lower eyelid can of itself almost entirely cover the whole front of the eyeball. When the action of the orbicularis ceases, the lower eyelid falls back into its former state by its own elasticity and that of the skin of the cheek. The lower eyelid has no depressor muscle analogous to the levator of the upper eyelid. In the skin of the lower eyelid, however, there appear to be organic muscular fibres, by the tonic contraction of which the tarsal border is capable of being somewhat depressed. This depression of the lower eyelid may be excited by rapidly stroking its surface with the point of the finger covered with a handkerchief. It is to be remarked that by this, depression of the lid of the other side, though untouched, is at the same time excited. It is by the levator palpebræ that the open state of the upper eyelid is maintained. In winking, the upper eyelid falls and the lower rises considerably, in consequence of the momentary action of the orbicularis.

Nictitation may be observed to be morbidly frequent. The eyelids may be affected with a twitching or quivering motion, which is, however, sometimes so slight as not to be very apparent to the observer, though felt by the patient himself as a very annoying throbbing. Or, they may be spasmodically closed intermittently, or remittently, or continuously—a symptom usually of the presence of a foreign particle in the eye, inflammation of the conjunctiva, or of intolerance of light.

The movements again may be defective, or lost from paralysis. There may be a constant open state of the eye, from palsy of the orbicularis muscle—*paralytic lagophthalmus.* Or, the upper eyelid may hang down over the eye from palsy or atony of the levator palpebræ superioris—

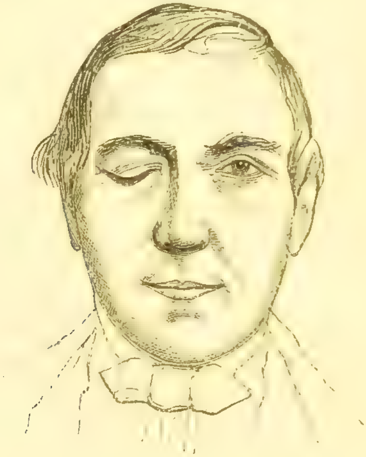


Fig. 1. (From Donders.)

paralytic ptosis. In the former case, there will probably be found palsy of the other muscles of the same side of the face; in the latter, on raising the eyelid with the finger, the eyeball will probably be found more or less fixed in an outward direction (Fig. 2), incapable of being turned inwards, upwards, or downwards, from concomitant paralysis of those muscles of the eyeball which, in common with the levator palpebræ, are supplied by the third pair of nerves;—perhaps also dilatation of the pupil.

The eyelids may be the subject of various injuries, such as burns and scalds; contusions with ecchymosis; wounds incised, or lacerated, or poisoned, as by the stings of the scorpion, wasp, &c.

The eyelids are sometimes the original and principal seat of erysipelas. In erysipelas of the face they are always involved. They may be the seat of phlegmonous inflammation, in which case the redness, which is intense, and swelling, are circumscribed, and the part very painful to the touch. Sometimes they present black sloughs from gangrenous inflammation. Both erysipelatous and phlegmonous inflammation of the eyelids are to be distinguished from the inflammatory œdema of those parts, which attends some of the inflammations of the eye,

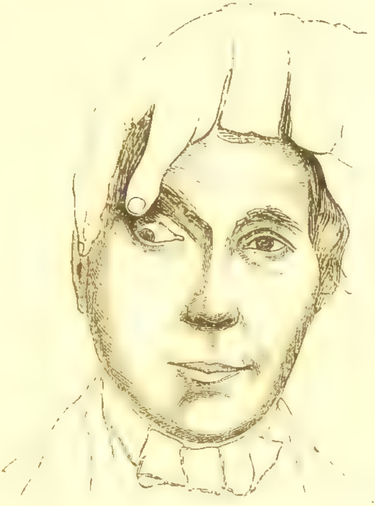


FIG. 2. (From Donders.)

especially acute inflammation of the lacrymal sac and the purulent inflammations of the conjunctiva.

The eyelids are often simply œdematous, sometimes emphysematous.

In children the eyelids are frequently affected with porrigo larvalis.

The eyelids may be the seat of syphilitic ulcerations. In infants affected with syphilis, the eyelids, and other parts of the face and body, are covered with an eruption of flat broad pustules (*syphilitic impetigo*), which break, scab, and spread. Such children have often a peculiarly wrinkled and withered expression of face.

The eyelids may be the seat of nævus maternus, of warts, and of different kinds of tumours. Lastly, they may be found cancerous.

In regard to the tarsal borders of the eyelids, it is to be premised that they are broad surfaces. The border of the upper eyelid is about one-twelfth of an inch broad; that of the lower about one-fifteenth. The edge bounding the border anteriorly corresponds to the insertion of the eyelashes and is round. The posterior edge is much sharper and more defined than the preceding, and is the place where the delicate integument of the border of the eyelid is continued into the palpebral conjunctiva. On the border of either eyelid, between the two edges or boundaries just described, but nearer the posterior than the anterior, and parallel to them, there is observable, on close inspection, a row of minute pores—the excretory mouths of the Meibomian follicles. Fig. 3, p. 11.

The tarsal border of the eyelids may be found inflamed—perhaps ulcerated (*ophthalmia tarsi*), in which case the eyelashes will be incrusted partly with dried Meibomian discharge, partly with the discharge from the ulcers. *Hordeolum*, or stye, is a furuncular form of inflammation of the free margin of the eyelids. Inflammation and abscess of the Meibomian follicles simulate the appearance of stye externally, but is a rarer occurrence. The eyelids, at their edges, or close to their edges, may present small tumours, thickening, and callosity, unattended by any great degree of inflammation, viz., chalazion, tylosis, &c.

The eyelashes are sometimes the seat of *phtheiriasis*, which is apt to be overlooked, except a close inspection with a magnifying-glass be made. *Madarosis*, or loss of the eyelashes, is at once recognised.

The eyelashes are often found in greater or less numbers turned in against and irritating the eyeball, constituting *trichiasis* and *distichiasis*. The surgeon should always take particular care to assure himself, therefore, of the direction of the eyelashes in cases of chronic ophthalmia: and in order to do so, and to see properly the broad surface of the tarsal border, and the state of the Meibomian apertures, the eyelids should be slightly everted by gentle pressure with the point of the finger on the skin of the eyelid, the eyelashes being kept between the finger and the skin.

By this means it will generally be at once seen if any of the eyelashes are growing in against the eyeball. Sometimes, however, such eyelashes are so pale and fine that they are apt to escape notice. The presence of these may often be detected by attention to the following point when they might otherwise be overlooked:—the tears, of which there is in such cases generally more than usual, rise up around the pale misdirected eyelashes, and between the eyelid and eyeball, by capillary attraction, and occasion a marked reflection of light at the place. It is necessary to look not only for inverted eyelashes, but also for hairs that may be growing in unusual situations, as, for example, the inner surface of the tarsal border. The internal angle of the eye should also be examined, lest any of the small hairs which naturally grow from the caruncula lacrymalis may have become a source of irritation from a morbid increase of their length. In making this examination for faulty eyelashes, the aid of a magnifying-glass is required.

We occasionally find, especially in children labouring under scrofulous ophthalmia, a fasciculus of the eyelashes of the upper eyelid at the outer corner, which has been accidentally turned in under the lower eyelid, and retained in this false position by spasmodic nictitation.

One or more of the Meibomian apertures may become covered with a thin film, apparently of epidermis, which prevents the escape of the secretion, so that the latter accumulates and raises the film up into a small elevation like a phlyctenula. The Meibomian discharge is increased, whenever there is any irritation of the edges of the eyelids, and especially of the palpebral conjunctiva.

The posterior edge of the tarsal border, which is in its natural state sharply defined, may be found rounded or obliterated, in consequence of chronic inflammation of the palpebral conjunctiva and of the integument of the tarsal border.

3rd. *Exploration of the conjunctival surface of the eyelids, and of the palpebral sinuses.*

The lower eyelid is everted for the purpose of examining its inner surface, by simply drawing down the skin of the lid and cheek; and in order that the lower palpebral sinus may be fully exposed, the patient is to be desired to turn the eyeball upwards, while the lower eyelid is thus held down and everted.

The upper eyelid does not admit of being so readily everted as the lower; and as the operation is attended with some uneasiness to the patient, it ought not to be had recourse to unless the glimpse of the inner surface of the eyelid, which may be obtained by raising the upper eyelid, and drawing it slightly from contact with the eyeball by pressing up the skin of the eyebrow and eyelid itself, prove insufficient to satisfy the surgeon of the state of the parts. If there is reason to suppose that a foreign body is lodged under the eyelid, then eversion is the only means of detecting and removing it.

In order to evert the upper eyelid, lay hold of the eyelashes between the forefinger and thumb of the right hand, for the right eye—and *vice versâ*—in such a way, that whilst the eyelashes are securely held, the points of the thumb and forefinger may extend a little beyond their insertion, so that the former may be applied to the broad border, and the latter to the outer surface of the eyelid. Having thus got a secure hold of the eyelid, draw it away from contact with the eyeball, and then, whilst applying counter pressure downwards on the outer surface of the eyelid, opposite the orbital margin of the tarsal cartilage, raise the ciliary margin upwards. The counter pressure may be applied either by the thumb of the free hand, or, what most people find better adapted to the purpose, by a thick probe. Another mode of everting the upper eyelid, which, however, does not succeed well when there is much swelling, is this:—The patient being directed to look downwards, the point of the forefinger of the right hand, if it be the left eye of the patient which is to be operated on, and *vice versâ*, is applied a little above the orbital margin of the tarsal cartilage, and by a slight pressure the upper eyelid is brought down before the lower, its free border being turned forwards at the same time. By then applying the thumb to the conjunctival surface the eyelid is got hold of, and may be everted by bearing somewhat on its outside with the forefinger.

The whole extent of the upper palpebral sinus cannot be exposed like the lower. To explore it a probe must be used, whilst the everted lid is kept as much as possible withdrawn from the eyeball, and the patient directed to look downwards.

By everting the eyelids, the state of the palpebral conjunctiva is ascertained; whether it be inflamed or granular, and whether there be growths connected with or projecting at the inner surface of the eyelids, as chalazia. The state of the Meibomian glands is likewise ascertained. By the eversion of the upper eyelid foreign bodies in the eye are readily detected and removed: small particles being especially liable to adhere to its inner surface.

The palpebral conjunctiva and edge of the eyelids I have found the seat of diffused vascular nævus simulating inflammatory congestion.

4th. *Exploration of the angles of the eye, and of the lacrymal organs as regards their general state.*

The inner and outer corners of the eye, where the eyelids join, are called *canthi*. The outer canthus, generally speaking, forms an acute angle; but on close examination it is observed that the apex is rounded off, somewhat prolonged and turned slightly downwards. The conformation of the inner canthus is altogether peculiar and rather complicated. At the inner canthus, the palpebral fissure is prolonged into a secondary fissure, the borders of which being destitute of cartilage, are not firm and square, but soft and rounded. The secondary fissure is closed by the action of the orbicularis muscle at the same time as the eyelids. The space within the inner or nasal canthus is called *lacus lacrymalis.*

The state of the outer canthus is readily ascertained by slightly drawing the eyelids from each other. The most ordinary morbid condition met with there, is abrasion or ulceration of the skin. Sometimes there is eversion—sometimes inversion.

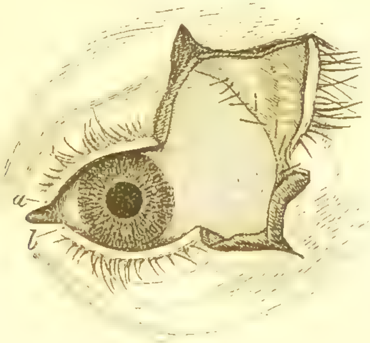


Fig. 3.

An eye, with the eyelids divided vertically, and the outer halves everted, to show the orifices of the ducts of the lacrymal gland, into which hairs are inserted. The letters *a* and *b* indicate respectively the upper and the lower puncta lacrymalia. Along the border of the eyelids are observed the Meibomian apertures.

The parts situated at the inner canthus are exposed, by drawing the eyelids from each other, and at the same time slightly everting them. At the inner extremity of the border of either eyelid, where the fissure of the nasal canthus begins, the papillary eminence called *lacrymal papilla* is seen, with the small orifice in its summit called *lacrymal point*, of such a size as to admit a bristle. These lacrymal points are, from their larger size and situation, sufficiently conspicuous not to be confounded with a Meibomian aperture. In the natural state, the lacrymal papillæ are inclined towards the lacus lacrymalis. The lower papilla is somewhat more prominent than the upper, and situated somewhat more towards the temple. Within the substance of the rounded borders of the secondary fissure at the inner canthus, the lacrymal canalicules run from the lacrymal points convergingly to the lacrymal sac. At the bottom of the lacus lacrymalis, is the lacrymal caruncle, and between it and the white of the eye, the semilunar fold. The semilunar fold and lacrymal caruncle may be found swoln and enlarged (*encanthus inflammatoria*); sometimes the seat of growths (*encanthis fungosa*).

In reference to the exploration of the state of the secreting lacrymal organs, it is to be remembered that the lacrymal gland consists of two masses, an upper and a lower. The former is that which lies in the lacrymal fossa of the frontal bone; the latter, composed of a loosely connected aggregation of small lobules, extends from the upper mass down to the outer part of the upper margin of the tarsal cartilage of the upper eyelid, in the substance of which it lies at the outer part, and may be seen shining through the conjunctiva on everting the upper eyelid. The ducts of the lacrymal gland are some twelve in number or more, very slender, and open by as many minute orifices on the surface of the conjunctiva, lining the inside of the upper eyelid, arranged in a row, extending from the outer canthus inwards for about half an inch, and parallel to, but a little above, the outer part of the upper margin of the tarsal cartilage. One or two may also be met with on the inner surface of the lower lid near the outer canthus. Fig. 3.

In exploring the derivative lacrymal organs, the appearance of the region of the lacrymal sac should be particularly noted. If there is marked redness, circumscribed swelling, and pain even on the slightest touch, with great œdema of the eyelids, the case is one of *acute* *dacryocystitis.* If there is less marked redness, merely unnatural fulness, with pain only on pressure, and when pressure is made, if there takes place regurgitation of tears with puriform mucus, through the puncta, the case is one of *chronic dacryocystitis.* If there is a large indolent tumour, more or less hard, perhaps livid, pressure on which does not cause any evacuation of matter either through the puncta or into the nose, the case is one of *mucocele*: it is to be remembered, however, that exostosis of the bony wall behind the lacrymal sac sometimes occurs, causing a tumour of closely similar characters. If there is a large flaccid tumour without pain, much or any redness, readily yielding to the pressure of the finger; and if on that pressure a mucous matter is evacuated through the puncta, but especially into the nose, the case is one of *relaxation of the lacrymal sac.* Lastly, if there is a fistulous opening leading into the sac, the case is one of *fistula of the lacrymal sac.*

Inflammation of the skin and subjacent cellular tissue in the region over the lacrymal sac sometimes occurs, running into diffuse abscess (*anchilops*), which, bursting externally, leaves a sinuous ulcer (*ægilops*). This sinus sometimes communicates by ulceration with the lacrymal sac, constituting what is called *spurious fistula* of it.

The state and position of the lacrymal papillæ and puncta should next be examined. The latter are sometimes found congenitally imperforate.

In addition to the examination now detailed, instrumental exploration of the derivative lacrymal passages may in certain cases be required, to determine the nature and seat of obstruction. But for this, see under the head of diseases of the lacrymal organs. The nostrils at the same time require to be looked to.

The state of the lacrymal discharge is to be noted. If the eye is overflowing in tears, it is to be determined whether this is owing to increased discharge from the gland—*epiphora*—or to diminished or obstructed derivation of the tears towards the nose—*stillicidium lacrymarum.* The point is determined by ascertaining the state of the deriative apparatus. If this is free from disease, the case is one of epiphora; if not, it is one of stillicidium. It is, however, to be observed, that stillicidium and epiphora may co-exist.

5th. *Examination of the form and appearance of the eyeballs generally, their size, degree of prominence, and consistence.*

The eyeballs, otherwise healthy, may be unusually prominent, apparently from infiltration of the orbital cellular tissue. This state of eyes is sometimes found along with anæmia and goître. In a case of hæmorrhagic extravasations in different parts of the body, there was intra-ocular extravasation, and extravasation within the orbital capsule, giving rise to exophthalmos. In inflammation of the orbital capsule there is inflammatory exudation within it, and under the conjunctiva, giving rise to great prominence of the eyeball, and distension of the eyelids. The exudation under the conjunctiva in this case, constituting one form of *chemosis*, is not so great around the cornea as at the circumference of the eyeball. In a case of echinococcus cyst in the orbit, the eyeball was protruded and disorganised (*exophthalmia*).

When the eye is prominent from the presence of a growth in the orbit, it will probably be at the same time misdirected.

Prominent eyes point to a *myopic* state of sight; sunken eyes to the opposite state of *hypermetropia*.

In general dropsical enlargement, the eyeball may not be much, if at all, misshapen, nor also in the early stages of encephaloid tumour, &c. But in staphylomatous enlargement, and when the encephaloid tumour is much advanced, there is very evident alteration of form and appearance, as well as increase of size and prominence.

In atrophy, the appearance of the eyes, in all these respects, may be little or not at all changed, but it is found soft to the touch. In a greater degree of atrophy, the eyeball is indented in the situation of the insertions of the recti muscles.

The eyeball is sometimes found congenitally very small (*microphthalmos*).

Consistence of the eyeball to the touch.—By pressing on the eyeball with the finger through the medium of the tarsal edge of one of the eyelids, the consistence of the eyeball should be ascertained; whether it be normal or of unusual hardness or softness. Hardness of the eyeball indicates too great quantity of the vitreous humour. Softness or flexibility of the cornea or sclerotica, indicates atrophy of the vitreous body. In either case, and sometimes even when the eyeball is of natural consistence, there may be dissolution of the hyaloid membraneous structure.

6th. *Examination of the direction and movements of the eyeballs.*

In simple convergent strabismus, or squint, one eye is habitually turned inwards, while the other is properly directed; in divergent squint, the misdirection of the eye is outwards.

In strabismus, if the properly directed eye be shut, the patient immediately regains command over the previously squinting eye so as to be able to direct it to any object.

Both eyes are usually affected with squint, though one only appears to be so. To determine this, in the case of convergent squint, for example, cover the eye which appears well directed, by holding the hand before it, and desire the patient to look straight before him with the previously distorted eye. While he is doing so, look behind the hand at the other eye, and it will now be seen distorted.

Convergent strabismus is generally met with in children, or is found to have originated in childhood, and to be in a large proportion of cases connected, as has been shown by Dr. Donders, with a hypermetropic state of sight.

Divergent strabismus, on the contrary, usually manifests itself at a later period of life, and occurs in connection with a myopic state of sight.

It has been above (page 6) remarked, that in paralytic ptosis the eyeball may be found incapable of being turned inwards, upwards, or downwards, from coincident paralysis of the internal, superior and inferior recti muscles, which, in common with the levator palpebræ, are supplied by the third pair of nerves.

Incapacity to turn the eye in the above-mentioned directions may, however, not be accompanied by much, if any, ptosis. The power of the external rectus being unimpaired, the eyeball is readily turned towards the temple. The case, therefore, might at first sight be taken for one of divergent strabismus. The continued inability to turn the eyeball inwards when the opposite eye is shut, will, however, at once distinguish it from that defect; whilst the concomitant paralysis of the superior and inferior recti will point to the nature of the case.

Inability to turn the eyeball outwards indicates paralysis of the external rectus. As there is some inclination inwards in consequence of the unrestrained action of the internal rectus, the case requires to be distinguished from convergent strabismus. By closing the opposite eye, therefore, it will be seen that the patient is still unable to turn the eye towards the temple.

Such cases of *luscitas*, or immobility of the eye in a particular direction from paralysis, are to be distinguished from the *luscitas* depending on organic contraction, &c., of the muscle of the side to which the eyeball is turned. Cases sometimes come under notice in which immobility of the eyeball inwards, with undue prominence of it and retraction of the semilunar fold, has resulted from the operation for convergent squint.

A partial rotatory movement of the eyeball to and fro on its antero-posterior axis (*oscillation*) may be met with; or a movement from side to side—(*nystagmus*). These irregular movements of the eye are of most common occurrence in persons whose sight has been defective from an early period of life.

7th. *Exploration of the anterior surface of the eyeball.*

The points to be noted in this examination are :—the state of the white of the eye, that is, of the ocular conjunctiva, and of the anterior part of the sclerotica, including the expansion of the tendons of the recti muscles underneath, and the state of the surface of the cornea.

Mode of exposing the front of the eyeball for examination.—The patient should be seated by a window, in such a way that the light falls obliquely on the eye to be examined from the temporal side. The surgeon, then, placed before the patient, applies the pulp of his thumb on the skin of the upper eyelid, previously well dried, near its ciliary margin whilst it is gently closed, and raises it by traction of the skin. In doing this, no pressure should be made on the eyeball, but the skin of the raised eyelid may be secured by pressure against the margin of the orbit. The lower eyelid is to be depressed to the extent that is necessary in a similar way, by the fore or middle finger of the other hand. In separating the two eyelids, however, it is to be remembered that when the upper is much raised, the lower should not be much depressed; and when the lower is much depressed, the upper should not be much raised, in order to avoid putting the external commissure too much on the stretch.

The eyelids being thus opened, the surgeon can look directly into the eye, or from any one side, by requesting the patient to move the eye in different directions.

To avoid irritating the eye too much, the eyelids should not be kept more than a few seconds separated at a time; they should be occasionally allowed to close, and after a few seconds, reopened when the examination requires to be prolonged.

For the examination of the eyes in children, especially when affected with intolerance of light and blepharospasmus, considerable management is required, and even some degree of gentle force.

The surgeon is to seat himself on a chair, with a towel folded longways, laid across his knees. On another chair, on the surgeon's left hand, and a little in front of him, the nurse, with the child, sits in such a way that when she lays the child across her lap, its head may be received on the towel, and between the knees of the surgeon, and thus held steadily. The nurse now confines the arms and hands of the child, whilst the surgeon, having dried the eyelids with a soft linen cloth, proceeds to separate them by applying the point of the forefinger of one hand to the border of the upper eyelid, and the point of the thumb of the other hand to the border of the lower, and then sliding them against the eyeball, but without pressing on it, towards their respective orbital edges. This mode of proceeding obviates the eversion of the eyelids, which is so apt to take place under the circumstances. The eyelids being thus opened, they are readily kept so during the examination, by the command which the points of the finger and thumb, resting against the edges of the orbit, have of their borders.

By this means the whole front of the eyeball is exposed, but it often happens that, to avoid the light, the eye is spasmodically turned up, so that the cornea is in a great measure concealed. By waiting a few seconds, however, enough of it will in general come into view to enable the surgeon to judge of the state in which the eye is. Having completed this part of the exploration, there is not much difficulty in so everting the eyelids as to ascertain the state of the palpebral conjunctiva.

State of the white of the eye—ocular conjunctiva.—The ocular conjunctiva is connected to the sclerotica underneath by cellular tissue loose enough to allow the former to slide somewhat upon the latter. At the margin of the cornea the cellulo-vascular and nervous basis of the sclerotic conjunctiva stops — what of the conjunctiva extends over the cornea being reduced to the epithelium. This epithelium, however, forms a thicker layer than on the sclerotic conjunctiva. It is, of course, intimately adherent to the proper substance of the cornea.

The bloodvessels of the ocular conjunctiva ramify in a direction from the circumference of the eyeball towards the cornea, and form a vascular circle or wreath around it, but send no vessels in the healthy state into it. Except the ramifications of the seven recto-muscular veins, which are often enlarged and tortuous, the vessels of the ocular conjunctiva can be seen only in the inflamed state of the membrane.

The presence or absence of redness is a point which should be first noted in exploring the state of the ocular conjunctiva. If there is redness, it is easy to determine whether it be the redness of ecchymosis or the redness of inflammatory congestion. The redness of ecchymosis is dark and occurs in patches, abruptly defined, without any appearance of vascular ramifications; whilst the redness of inflammatory congestion presents contrary characters, as will be detailed in their proper places.

The ocular conjunctiva may be the seat of pustules, or of growths of various kinds, such as pterygium, pinguecula, warts, fungus, trichosis, and the like. It, as well as the palpebral conjunctiva, and even the cornea, may be found stained of a dark olive hue from the long-continued use of nitrate of silver drops.

Injuries of the conjunctiva, whether mechanical or chemical, force themselves on the attention; as also, in general, the presence of foreign bodies in the oculo-palpebral space.

The cellular tissue between the conjunctiva and sclerotica is sometimes the seat of extravasations of blood, *subconjunctival ecchymosis*; sometimes the seat of serous exudation, as in the œdema attending erysipelatous ophthalmia; sometimes the seat of a more serious inflammatory exudation by which the conjunctiva is much raised up around the cornea, less so at the circumference of the eyeball, constituting that form of *chemosis* which is common in the purulent inflammations of the conjunctiva. It may also be the seat of emphysema, and is occasionally so of phlegmon.

State of the white of the eye—sclerotica, including the tunica tendinea, or expansion of the tendons of the recti muscles.—In the natural state, the sclerotica, including the tunica tendinea, is white and glistening, like other fibrous membranes. The peculiar appearance of the white of the eye is owing to its shining through the semi-transparent conjunctiva. The bluish tinge of the white of the eye in childhood is owing to the thinness of the sclerotica at that time of life, allowing the dark choroid to shine through.

In the healthy state, the sclerotica is even more bloodless than the conjunctiva. The bloodvessels seen in it in certain inflammations are very minute, and converge in straight lines towards the margin of the cornea. Opposite the insertion of the ciliary ligament, some of these vessels pierce the sclerotica to gain the interior of the eye, where they join the vessels of the iris; whilst others anastomose with the circumcorneal vessels of the conjunctiva.

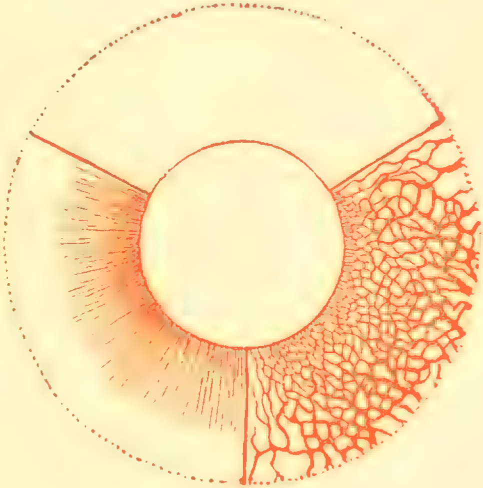


Fig. 4.

If the white of the eye is red from inflammation, the seat of the vascularity, whether in the conjunctiva or sclerotica, becomes a question. In conjunctival inflammation, the vessels of the sclerotic conjunctiva are large, somewhat tortuous, and arranged in a reticular manner;

the colour is scarlet, or brick red, and it may be deeper towards the orbit, but more or less shaded off towards the cornea. In sclerotic injection, the redness is in the form of a pink or lake-coloured zone, encircling the cornea; the injected vessels being very minute, and disposed in straight radiating lines, as if from its margin, where the tint is deeper, whilst it is shaded off, and disappears towards the orbit, the converse of what occurs in the injection attending conjunctival inflammation. The seat of the injected vessels, whether in the sclerotic conjunctiva, or in or on the sclerotica itself, is easily proved, supposing any doubt exist, by making the conjunctiva slide on the sclerotica, when the vessels, if seated in the conjunctiva, will be observed to move along with it, whereas, if seated in the sclerotica, or closely applied to its surface, they will remain stationary. When both conjunctiva and sclerotica are injected at the same time, the pink hair-like vessels of the sclerotica are seen stationary through the larger meshes of the sliding conjunctiva. But when the conjunctiva is very much injected, the state of the sclerotica cannot be seen.

Such are the characters of conjunctival and sclerotic vascularity generally. Certain varieties remain to be noticed, viz.:—The circumscribed spot of injection with a small pustule or flake of matter in the middle, seated in the ocular portion of the conjunctiva at some little distance from the margin of the cornea, which presents itself in pustular ophthalmia. The fasciculus of enlarged vessels in the conjunctiva running towards the cornea, which, at its edge or towards its middle, is the seat of a phlyctenula, or ulcer, so common in scrofulous ophthalmia. Fascicular vascularity in the situation of the tendinous insertion of the recti muscles,—most commonly the external rectus,—and extending to the margin of the cornea, in a particular form of sclerotitis. The large and dark-red tortuous vessels pervading the white of the eye, met with in internal congestion of the eye and chronic posterior internal ophthalmia.

Growths and tumours on the white of the eye are to be examined as to whether they have their seat in the conjunctiva only as in *pterygium*,—or are imbedded in the subconjunctival cellular tissue, as in *hydatid cysts*,—or have their roots in the sclerotica, as in *trichosis bulbi*. The sclerotica may be found in some part unnaturally prominent and bluish-black—*sclerotic staphyloma.*

State of the cornea.—The prominence and breadth of the cornea, the state of its margin, its connection with the sclerotica, and its transparency and non-vascularity in the mature and healthy state, as also its relations to the iris, and its composition of three principal layers of different tissue, viz., the proper substance, forming its principal thickness; the thick epithelium, or conjunctival layer on its anterior surface; and the membrane of Descemet with its tessellated epithelium on its posterior surface: are circumstances to be had in remembrance in examining whether it be the seat of disease.

In order to ascertain the prominence of the cornea, a profile examination of it should always be made. The cornea may be found unnaturally prominent; the prominence may be spherical, as in dropsy of the aqueous chambers after *corneitis*, or conical as in *conical cornea.* In the early stage of the latter affection, the conical prominence may not be very evident in a profile examination. In such a case, the small brilliant reflection of the light from the apex of the commencing prominence will betray its existence.* Besides these unnatural states of prominence, in which the transparency of the cornea is usually still more or less retained, there is the opaque prominence of staphyloma, which may be either partial or complete. The cornea may be found unnaturally flat. By a profile examination, also, it will be seen in any doubtful case whether an opacity is seated in the cornea, or not. Facets and small ulcers of the cornea will also be detected.

In certain morbid states of the eye, the smoothness and polish of the surface of the cornea is lost, without any appearance of opacity. The change is detected, on examination with a magnifying glass, by the diffuseness and irregularity of the reflected image of a light.

The usual diameter of the cornea is 9-20ths of an inch transversely, somewhat less vertically, the outline of the cornea not being quite circular, but rather oval, and this in the literal sense; its small end being that next the temple. Any morbid increase or diminution of diameter which the cornea may present, is usually an accompaniment of increase or diminution in the size of the eyeball generally.

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* See also *infra*, p. 59, how the existence of conical cornea, which may have been overlooked on external examination, may be detected under the ophthalmoscope.

State of margin of the cornea.—Externally the sclerotica overlaps or encroaches more or less on the edge of the cornea. In certain constitutions, and especially in old persons, the overlapping part of the sclerotica is thicker and more opaque than usual—perhaps also encroaches more extensively on the cornea. The conjunctiva covering the overlapping sclerotica, especially when the latter is to any considerable extent, is, like the sclerotic conjunctiva generally, composed of both chorion and epithelium; and although it adheres to the subjacent overlapping part of the sclerotica very closely by cellular tissue, it by no means presents the same intimate union with the subjacent structure which the extension of conjunctival epithelium over the transparent cornea does. The conjunctiva covering the overlapping part of the sclerotica has a vascular connection with the latter, no otherwise than by the anastomoses of the proper vessels of each—a vascular connection which indeed subsists between the sclerotica and conjunctiva elsewhere. The disposition just described is connected with a point in the pathology of the eye, viz., the bluish-white ring which is observed to encircle the cornea more or less completely in certain internal inflammations of the eye, and so frequently in what is called arthritic iritis, that it has been considered a diagnostic of it, but certainly without just grounds.

In reference to the cause of the appearance, it is to be remembered that the insertion of the ciliary ligament is at some little distance from the apparent margin of the cornea; that the vessels which form the red zone of the sclerotica in the internal inflammations of the eye, and in inflammation of the proper substance of the cornea, are vessels which send branches inwards to the iris, opposite the ciliary ligament, branches outwards to anastomose with those of the conjunctiva, and, lastly, branches which, following the original direction, go to be continued into those newly developed in the proper substance of the cornea. These vessels are not apparent in the healthy state, and one set of them only may become apparent in inflammation. Thus, in inflammation of the iris, they will be apparent only as far as opposite the insertion of the ciliary ligament. Between this and the clear part of the cornea is the opaque overlapping part of the sclerotica, which of course, not being in the way of the progress of the vessels towards the inflamed part, remains white as usual; and the cornea not being affected, there are no vessels developed in its proper substance. Hence the overlapping part of the sclerotica is seen in contrast between the abruptly terminating red sclerotic zone on the one hand, and the transparent cornea (appearing dark on account of the dark structure behind it) on the other, and forms the bluish-white ring.

From this explanation, the bluish-white ring round the cornea ought to exist more or less in all internal inflammations of the eye, unless obscured by vascularity of the conjunctiva in inflammation of the cornea. So it does; but in persons of otherwise sound constitution, and not of advanced age, the overlapping sclerotica is so transparent, and sometimes also so narrow, that it is not strongly contrasted by the transparent cornea. It is otherwise, however, in certain persons, especially such as are advanced in life, in whom the encroachment of the sclerotica and fully developed conjunctiva on the cornea exists to a great degree, and in a very opaque state; the bluish-white ring then appears in the exaggerated distinctness which has commonly attracted the notice of surgeons.

The condition of the eye necessary for the *distinct* appearance of the bluish-white ring round the cornea, occurring principally in old persons of bad constitution, and these being the very persons in whom an internal inflammation of the eye very often presents what is called the arthritic character, are circumstances which readily explain the error of supposing the bluish-white ring round the cornea diagnostical of arthritic iritis.

In degeneration of the structure of the cornea, the limit between its margin and the sclerotica may be quite obliterated.

Arcus Senilis (*Gerontoxon*), an annular opacity of the cornea within its circumference, which occurs in advanced periods of life, though it is sometimes observed below middle age, must not be confounded with the bluish-white ring round the extreme margin of the cornea, just described.

The opacity is about the twentieth or thirtieth of an inch broad, and has an equal breadth of nearly clear cornea intervening between it and the circumference of the cornea.

Arcus senilis appears first at the upper and lower parts of the cornea, and by-and-by extends all round, though this does not always happen.

It is never so extensive as to obstruct vision.

As shown by Mr. Canton, the opacity depends on a deposit of granular fat in the interstices between the corneal fibres, and is often an indication of the existence of fatty degeneration of the muscles of the eye, of the heart, and other organs.

The changes in the transparency which the cornea may present, are very various in seat, degree, extent, and nature. As regards seat, they are distinguished according to the different layers of the cornea which they implicate. But as regards nature especially, they are to be distinguished into those in which opacity is for the time merely a secondary consideration in the case, viz., phlyctenulæ, pustules, abscesses, and ulcers, which are concomitants of inflammation, and those in which the opacity, whether removable or not, is now the principal defect, viz., opacities properly so called.

A foreign body adhering to the cornea may simulate an opacity.

Minute opacities of the cornea, otherwise previously not very evident, are brought into view when the pupil is dilated, being rendered distinct by contrast with the black background formed by the pupil.

When in its mature state, vessels are observed in the cornea, they are new formations developed from the lymph exuded into its substance, from the vessels, in a state of inflammatory congestion, of the adjoining conjunctival or sclerotic circumcorneal zone. New vessels may be observed:—1, between the epithelium and proper substance; 2, in the proper substance; 3, between the proper substance and membrane of Descemet—these being the situations where lymph is exuded in inflammation.

Foreign bodies getting into the eye, especially when projected with force, may adhere to or become imbedded in the cornea. The cornea is subject to be variously injured by mechanical or chemical agents. Simple abrasion of the surface of the cornea by a scratch of the finger-nail, or the like, often gives rise to very severe symptoms. Certain chemical agents, such as mineral acids and lime, have the effect of rendering the epithelium of the cornea, in common with that of the conjunctiva, white and opaque, and causing it to become detached, and to peel off from the proper substance of the membrane.

The relation between the iris and cornea should not be passed unnoticed in reviewing the state of the cornea.

When the cornea is penetrated by ulcer or wound, the aqueous humour escapes, and the iris is apt to be prolapsed. Of this prolapsus iridis there may be different degrees, according to the extent of destruction of the cornea; and as effects of different degrees of former prolapsus, there may be found *synechia anterior*, *partial staphyloma*, *total staphyloma*.

The cornea may be the seat of growths and tumours.

8th. *Lateral or oblique illumination as a means of exploring the anterior segment of the eyeball.*

In exploring the state of the interior of the eye, illumination greater than is afforded by the window merely, is necessary. The light concentrated by means of a convex lens, about two inches in diameter, and three or four inches focus, or by means of a concave mirror, is sufficient for all practical purposes, in the case of the anterior segment of the eyeball, comprising the cornea, aqueous humour, iris, pupil, and crystalline body.

Exploration of the interior of the eye by the light of a gas flame concentrated by means of a convex lens is a method long ago employed and recommended by Dr. Mackenzie ("Practical Treatise," pp. 583, 744, and 1025, 4th edition).

The pupil being dilated, Dr. M. has been in the habit of concentrating the light with a double convex lens, and letting the focus fall within the eye, for the purpose of exploring not only the parts of the anterior segment, but even the state of the vitreous, effusions behind and pushing forward the retina, and certain other morbid states of the posterior segment. With ordinary daylight concentrated on the pupil by means of a double convex lens, all the particulars respecting the opaque appearance in cataract may be observed; but for the exploration of the deeper parts, the concentrated light of the gas flame is necessary.

With the large convex lens the light is to be thrown into the eye from one side and a little in front, while we observe from the other; and, according to the mode of holding the lens, we can direct the focus of light into the different depths and on the different parts of the anterior segment—the cornea, aqueous humour, iris, pupil, lens.

In using the reflecting concave mirror of an ophthalmoscope for oblique illumination, the source of the light should of course be by the side and a little behind the patient. The observer does not look through the aperture, but by the side of the mirror, so that he sees the objects under examination by the rays of light reflected obliquely from them.

At the time that the parts of the anterior segment of the eye are thus illuminated, we may examine them in detail with a magnifying glass of about three inches focal length.

By this mode of illumination, we see the objects in their proper colours; whereas, by the direct illumination by means of the ophthalmoscope they appear black: thus, a white or grey streak of opacity in the lens is seen as such by oblique illumination, but appears black under the ophthalmoscope.

9th. *Exploration of the interior of the anterior segment of the eye.*

State of the anterior chamber, and aqueous humour.—The size and form of the anterior chamber are determined by the diameter and prominence of the cornea, on the one hand, and the position of the iris on the other—whether the latter inclines forwards to, or backwards from, the cornea—circumstances to be determined by examining the eye from the side (p. 27).

The state of the aqueous humour is next to be attended to—whether it is of natural transparency, or whether it be mixed with any foreign matters, in the form of lymph, pus, or blood.

State of the iris and pupil.—The colour, striated aspect, and position of the iris, and the state of the pupillary margin, are the points first to be noted; then the form, size, and especially the motions of the pupil.

When the iris is inflamed, its surface is dim-looking, and changed in colour—if blue to green; if blue-grey to green-grey; if green to yellow-green; if dark-brown to reddish-brown; if bright-brown to yellow-brown. Its pupillary circle is often distinctly reddish at first; but when lymph has been exuded into its substance, as in syphilitic iritis, the pupillary circle presents a tawny colour.

Change of the colour of the iris may also follow an injury of the eye from a persistence of vascular congestion; but it is sometimes met with in cases in which it is alleged there has been no preceding inflammation, or any other apparent cause. In the cases referred to, however, the change of colour is attended with some impairment of the sensibility of the retina, or with cataract, indicating that there is something wrong about the nutrition of the eye—probably venous congestion.

It is important to be aware that the two irides are sometimes naturally of a different colour, and that sometimes one half of the same iris is differently coloured from the other half. That such differences of colour are not the effect of iritis may be at once seen by the existence of the bright striated aspect of the surface of the iris, the regularity of the pupil, and the activity of its motions.

Sometimes dark spots are observed on the iris, looking as if its proper substance were at the place gone, and the uvea appearing, or even protruding through. Somewhat similar spots may be met with in healthy eyes; but the spots here referred to are met with, and sometimes very large, after long-continued unhealthy inflammation of the iris,—syphilitic, arthritic, or cachectic. In such cases, the pupillary margin is adherent to the lens, and the middle of the iris projects towards the cornea. The proper substance of the iris, which remains evident, is much changed in colour, and presents a peculiar fibrous appearance. This change in the structure of the iris is called *iridauxesis*, or *staphyloma uveæ*, from its having been supposed to be a thickening of the iris or a protrusion of the uvea through its proper substance.

In its natural state, the iris is, when the pupil is contracted, slightly pushed forwards by the lens towards the cornea. Sometimes it is met with, in consequence of different morbid states of the posterior segment of the eye, much inclined towards the cornea. A deceptive appearance of this often occurs, if the eye be viewed from the front only. All doubt is avoided by looking at it in profile, when, if the iris still retains its natural position, the pupil will be seen nearer the margin of the iris which is next the observer, as in Figure 5.

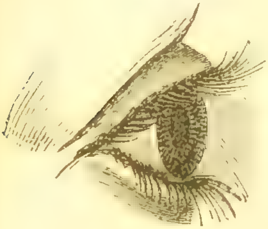

FIG. 5.

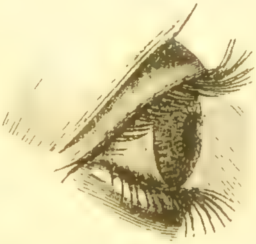

FIG. 6.

Whereas, if the iris be inclined towards the cornea, the pupil will be seen towards the opposite margin, as in Figure 6.*

After loss of the lens, the iris is inclined back from the cornea, being concave forwards, instead, as in the preceding case, convex. In certain cases of dropsy of the aqueous chambers without loss of the lens, I have found the iris much inclined backwards. Sometimes the iris is seen to be tremulous—to shake on every motion of the eye, which is supposed to indicate a dissolved state of the vitreous humour.

Besides other changes in the pupillary margin, such as the tawny colour in syphilitic iritis, thickening, a fringed appearance, &c., there may be, adhesion of it to the capsule of the lens (*synechia posterior*), producing distortion, contraction, and diminution in the mobility of the pupil. Analogous changes in the state of the pupil may be produced by other causes, but that they are owing to morbid adhesions will in general be observed, on careful examination, and very certainly if belladonna be applied: for by this, the pupil will be dilated at the free parts of its margin, and the adhesions rendered very evident, whilst the distortion of the pupil will be much increased.

The iris may be partially adherent to the cornea. Such a state is named *synechia anterior*, or *partial staphyloma*, according to the extent of the iris and cornea implicated, and the consequent presence or absence of prominence at the place. In this case also, the pupil is found distorted, contracted, and more or less confined in its motions. These changes are readily detected, especially by viewing the eye from the side, and by the use of belladonna.

The pupil may be found completely closed, and this state may be either simple or complicated, with morbid adhesions, &c.

Excrescences or tumours sometimes present themselves connected with the iris. The iris may be found detached at some part of its ciliary circumference by the protrusion of cysts or tumours from behind, but more frequently in consequence of injury.

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* It is curious to see how very generally artists, in representing the eye in profile, have committed the error of drawing the pupil as it appears only when the iris is unnaturally inclined towards the cornea. Another common mistake in profiles of the eye is the monstrous size of the palpebral fissure.

The deviations in the position, form, size, and especially the motions of the pupil, now to be noticed, are such as are independent of morbid adhesions.

The pupil does not always occupy the centre of the iris. In 164 individuals examined by Dr. Foucher in reference to this point, the pupil was central in 98; seated nearer the upper and nasal side in 31; nearer the upper margin in 15; nearer the inner margin in 12; nearer the upper and temporal side in 5.

Mode of examining the state of the pupil.—The patient is to be seated opposite the light. The surgeon, standing or sitting before him, closes both the patient's eyes by bringing down the upper eyelids. These he rubs over the cornea with his thumbs, and then suddenly opens one eye to the light, and carefully notices how far the pupil was dilated, and how quickly it contracts on exposure to the light. Both eyes are again to be closed and rubbed in the same way, and then the other eye suddenly opened and examined.

If the surgeon were to examine both pupils at the same time, by unshading both eyes simultaneously, a mistake might be committed, as the pupil of a blind eye may move in concert with that of the other which is sound. But when the movements of the pupil of the latter are prevented by its being shaded, the pupil of the former will in general be found to be quite unaffected by the light.

It is to be remembered that, in the healthy state, when one eye is covered, the pupil of the opposite one is rather more dilated than when both eyes are exposed to the light.

As in a paralytic limb tickling may excite movements, so in amaurosis, the pupils are sometimes found obedient to the light.

A sort of rhythmic alternate contraction and dilatation of the pupil, is sometimes met with named *Hippus*.

The pupil may be found much dilated, and either sluggish in its movements, or altogether immovable; or, it may be contracted, and either sluggish or immovable. In these cases, which are respectively named *mydriasis* and *myosis*, there may be no other disturbance of vision than what the size of the pupil and accompanying state of adjustment will account for, or there may be amaurotic defect of sight.

Changes in form or position of the pupil, not owing to morbid adhesions, are sometimes met with in syphilitic iritis, arthritic iritis, choroiditis, amaurosis—a result probably of some affection of the ciliary or iridal nerves.

In consequence of blows, &c., the iris may be detached at some part of its ciliary circumference, the result of which is a false pupil.

Persistence of the remains of the pupillary membrane is sometimes, though rarely, met with. In one case I found them simulating the form of bands of adhesion between the iris and capsule of the lens. Their real nature was recognised by the circumstance that they sprang not from the pupillary margin of the iris, nor from behind it, as adhesions do, but from the anterior surface of the iris, where the pupillary joins the ciliary ring, which is the place where the pupillary membrane is connected with the iris. In another case, the remains of the membrane presented themselves in the form of a small patch of membrane (partially covering the pupil) from which bands extended to the anterior surface of the iris where the pupillary joins the ciliary ring.

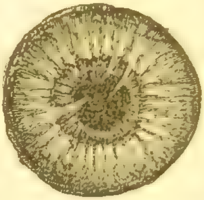

FIG. 7.

Imperfect development of the pupillary circle of the iris sometimes occurs.

Coloboma iridis, which consists of a fissure in the iris

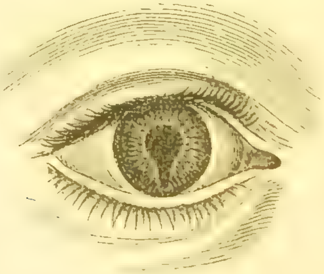

FIG. 8.

extending from the pupil towards the ciliary margin of the iris, is sometimes met with, either as a congenital malformation or as the result of injury.

Congenital absence of the iris sometimes presents itself. It is readily distinguished by the uniform dark, though not black, appearance behind the cornea; unless cataract has formed, which is, in general, sooner or later the case. If cataract has formed, the opaque lens is seen to its very circumference. In one case I found it displaced upwards.

A dark-red reflection from the bottom of the eyes when the light falls upon them in a certain direction, is seen in cases of congenital absence of the iris.

10th. *Artificial dilatation of the pupil.*

The dilatation of the pupil by belladonna, hyoscyamus, or stramonium, besides its use in the treatment of the internal ophthalmiæ, is a most valuable means of exploring the state of the pupil and the pupillary margin of the iris, as above shown, and also of exploring the nature and seat of opaque appearances behind the pupil, and the condition of the fundus of the eye, by means of the ophthalmoscope.

Belladonna is stronger in its action than hyoscyamus or stramonium. It is applied either in the form of extract, reduced to the consistence of honey with glycerine, which is smeared on the eyebrow and outside of the eyelids, or in that of a filtered solution of the extract (ext. belladonn. gr. xx., aq. destillat. ℥j.), which is dropped into the eye. Belladonna in the form of a solution of its active principle is now almost exclusively employed, thus:—Atropiæ sulphat. gr. j.—ij.—jv., aq. dest. ℥j. solve.

When the belladonna is applied in the form of soft extract externally, the dilatation of the pupil takes place less quickly than when applied in the form of a solution of atropia dropped into the eye, the effect in this case being produced in ten minutes or a quarter of an hour.

The dilatation of the pupil by a solution of the above strength continues for several days.

Besides dilatation of the pupil, another effect of atropia or other mydriatic on the eye is to produce an extreme state of adjustment for distance. This effect, which will be treated of below, does not take place quite so soon as the dilatation of the pupil, and gradually subsides as the pupil recovers its ordinary state.

Under the influence of a very weak solution of atropia (gr. j. to half a pint or a pint of water), dilatation takes place more slowly and passes off more quickly; while the adjustment is little or not at all affected.

11th. *Exploration of opaque appearances behind the pupil.*

The colour of the pupil varies according to the age of the individual examined: thus, whilst in the infant it is quite black, it appears greyish or even amber-tinted in advanced life on account of a considerable quantity of the light falling upon the crystalline lens being reflected by it, though not opaque.

Though the nature and seat of an opaque appearance behind the pupil may be, to a certain extent, determined by the experienced surgeon, without artificial dilatation of that aperture, it is always advisable, especially for the young surgeon, not to pronounce a formal opinion of the exact nature and seat of the opaque appearance, in any case, until after an examination has been made with the pupil dilated.

The pupil being dilated, oblique illumination enables us to ascertain the state of the crystalline lens very completely.

The lens, still transparent or opaque, is sometimes found congenitally displaced, so that the person sees past its edge instead of through its centre, though still transparent.

The various aspects under which anterior capsular cataract presents itself,—the streaks of opacity in the anterior cortical substance of the lens converging from the circumference, where they are broad, towards the centre, where they become narrow,—the concavity of the opaque surface when the deep cortical strata are alone or principally cataractous,—the amber-coloured nucleus shining through the greyish opaque cortical substance of the lens in the ordinary cataract of old people, are all distinctly seen.

In exploring the opaque appearances in the situation of the crystalline lens, we must be prepared to take notice of thin films of opaque lymph on the anterior wall of the capsule of the lens,—of bands of adhesion between the pupillary margin of the iris and the said wall of the capsule of the lens,—or brown spots of opacity where adhesions formerly were.

12th. *Catoptrical examination of the crystalline body.*

Preparatory to practising the catoptrical examination of the crystalline body, the student should make himself acquainted with the appearance of the images reflected by a double convex lens and a watch-glass. If he holds a candle before a double convex lens, he will see an inverted image of the former projected in front, and an upright image behind. The inverted image of the candle is owing to reflection from the concave surface of air in contact with the posterior convex surface of the lens. The erect image is produced by reflection from the anterior convex surface of the lens. If now, the student holds a watch-glass a little in front of the double convex lens, an erect image of the candle will be seen reflected by its convex surface, occupying a position anterior to that of the inverted image of the convex lens.

The pupil being dilated by belladonna, and the room darkened, if a lighted taper be held before the patient's eye, the surgeon will see three reflected images of it in the pupil, one behind the other, if the cornea and crystalline are of their natural transparency. Of these images, the anterior and posterior are erect, the middle one inverted. The anterior is the brightest and most distinct, the posterior the least so. The middle one is the smallest, but it is bright. If the taper be moved, the two erect images follow its motions in the same direction, but the inverted image moves in the opposite direction, though not so quickly, nor through so great a range as the other two. The anterior erect image is reflected by the cornea, and corresponds to that reflected by the watch-glass in the above experiment; the posterior erect image is reflected by the anterior surface of the lens, and the middle or inverted image, by the concave surface of the hyaloid fossa of the vitreous: the two corresponding to those of the double convex lens above described. According to M. Laugier, the posterior erect image is produced, not alone by the anterior wall of the capsule, but is so also by the anterior concentric layers of the lens. In the healthy state those layers, although of different densities, come to produce an image single in appearance. This is because the series of images reflected by each are very exactly superposed, so as to coalesce into one. It is this superposition of successive images which renders the posterior erect image so ill defined.

The posterior erect and the inverted images are not produced, if the anterior part of the crystalline body be opaque, whether the rest be opaque or not; but if it is the centre or the posterior part only which is opaque, the posterior erect image is produced, but not the inverted one. According to M. Laugier, the inverted image does not always disappear, though there is opacity of the anterior layers of the lens, sufficient to prevent the formation of the deep erect image. When the opacity is as yet slight, the images may be produced, but will be more or less indistinct. Of course the anterior erect or corneal image is not affected, unless the cornea is diseased.

For determining that the crystalline body still exists, the catoptrical test is of real practical value. In assisting the differential diagnosis of amaurosis and incipient cataract, and perhaps, in rare cases, of black cataract, its use was also considerable; but it has now been superseded by the ophthalmoscope. Ordinary cataractous opacity, by the time that operative interference is called for, can always be sufficiently well observed by ordinary examination as above indicated, p. 32. By the catoptrical test, it is not to be forgotten, however, that in 1838, Dr. Mackenzie illustrated and confirmed the fact, which he had discovered some ten years before, that the lens is the seat of the peculiar opaque sea-green appearance in glaucoma.

The opaque appearance in glaucoma.—The peculiar sea-green opacity in glaucoma appears deep, and changes its seat according to the direction in which the light is admitted to the eye, being always seen most distinctly on the side opposite the light. When the disease is advanced, the inverted image in the catoptrical examination is indistinct or obliterated.

It has been above stated that for all practical purposes, opacity of the lens can be sufficiently well ascertained by ordinary exploration with the pupil dilated. By means of the ophthalmoscope, adjusted for the purpose, however, otherwise undistinguishable opaque points, or streaks, can be seen. But it is of no advantage to push the diagnosis of opacity of the lens to such a minute degree of accuracy, seeing that we often meet with cataractous opacity, quite evident to ordinary examination, notwithstanding which there is still pretty good sight; whilst, on the other hand, cases occur in which the impairment of sight complained of is not at all to be accounted for by the appreciable opacity of the lens.

Cholesterine crystals in the interior of the eye.—A remarkable sparkling appearance produced by cholesterine crystals is sometimes observed in the interior of the eye, even without the aid of the ophthalmoscope. Dr. Hannover thinks that the cholesterine is always formed in the lens, and becomes free after operation for cataract. He therefore proposes the name *cataracta scintillans* instead of *synchysis scintillans*, commonly given to the morbid state in question, from the vitreous humour, in a dissolved state, being supposed to be the original seat of the cholesterine deposit.

In the cases referred to by Dr. Hannover, the cholesterine crystals do not appear to be set free by, but to be *deposited only* after, the operation for cataract. Cholesterine deposits, however, do no doubt take place in the vitreous humour, and also at the fundus. In all such cases, the general condition of the eye is found to be morbid.

§ II. THE OPHTHALMOSCOPE AND OBJECTIVE EXPLORATION OF THE INTERIOR OF THE POSTERIOR SEGMENT OF THE EYEBALL THEREWITH.

Whilst the light concentrated by means of a convex lens or of a concave mirror, and directed from the side obliquely on the eye, suffices in general for the exploration of the anterior segment; direct illumination by means of the ophthalmoscope is indispensable for the exploration of the posterior segment, comprising the vitreous body, retina and choroid.

Opacities of the crystalline lens are also discoverable by means of the ophthalmoscope, which might escape detection in the exploration by oblique illumination. On the other hand, we can assure ourselves of the transparency of the lens by means of the ophthalmoscope, which we cannot always otherwise do.

1st. *The Ophthalmoscope.*

The ophthalmoscope consists essentially of a reflecting mirror, with a small aperture in the centre, and the mode of using it is this :—

The patient being seated, and a light placed to the side of and a little behind his head, the observer holds the reflecting mirror at such an angle as to throw the rays from the flame into the eye to be examined, as much in the line of vision as possible ; and, while doing this, looks through the aperture of the mirror into the patient's eye as nearly as he can in the same direction as that which the light follows in being reflected into it from the mirror.

The interior of the eye is seen illuminated, because the rays of light are reflected from its fundus back through the aperture of the ophthalmoscopic mirror into the observer's eye.

The reason why we cannot see the fundus of the eye without the assistance of the ophthalmoscope is, that in looking directly into the eye through the pupil, the observer's head intercepts the light which should enter the patient's eye and be reflected back into his own.

Examining the eye with the ophthalmoscope in the manner just described, however, we see only the red reflection from the illuminated fundus. We cannot, except under certain conditions, see the different parts in a defined manner.

To make a complete ophthalmoscopic examination it is necessary that the pupil should be dilated. More light is thus admitted into the eye, the crystalline lens is exposed in the greater part of its extent, whilst the objects at the fundus of the eye—the papilla optica, retina, and choroid—are better seen. Besides, we have the eye in a fixed state of refraction, viz., its lowest. The solution of atropia, which has been dropped into the eye to produce the dilatation of the pupil, having at the same time excited to action the far-adjusting apparatus.

It is, however, in many cases not advisable to drop the solution of atropia into the eye ; for example, when there is internal congestion of the organ, such a state being liable to be aggravated by the action of the atropia ; or, when the temporary confusion of sight which might arise from the dilatation of the pupil and altered adjustment of the eye, would be likely to interfere with the convenient transaction of any business which the patient might have immediately on hand.

Without previous dilatation of the pupil by the instillation of a solution of atropia into the eye, we may often make a sufficient exploration for all practical purposes. We may satisfy ourselves whether the centre of the crystalline lens be still transparent; and, if so, we may observe the condition of the papilla optica and of the parts of the choroid and retina immediately adjacent thereto.

The various forms of ophthalmoscope now in use throw the light into the eye of the patient in a state of condensation. For this purpose the reflecting mirror has commonly a concave surface. In some it has a plane surface, on which, however, the light is condensed by means of a convex lens attached to the instrument, as in Coccius' ophthalmoscope. In Zehender's ophthalmoscope, the reflecting mirror has a convex surface, on which the light is condensed by a convex lens, as in Coccius' instrument. In another form of the ophthalmoscope, the reflection of the light, previously condensed by a convex lens, is effected by a prism, as in Meyerstein's instrument.

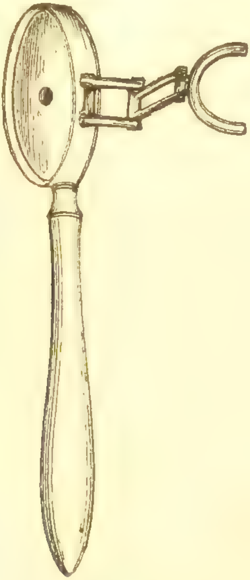

Fig. 9.

Ophthalmoscopes are either portable for hand use in ordinary practice, or they are fixed for making more precise and detailed explorations.

The simplest and most generally used hand ophthalmoscope is composed of a concave reflecting mirror of silvered glass or polished speculum metal, of five or six inches focal length, with a small perforation in its centre. At the back of the frame of the mirror, at the place where the perforation is, there is a ring or slot for the reception of a small lens, biconcave or biconvex, if the observer's eye should require the help of such. (Fig. 9.)

The mirror is furnished with a handle.

Besides the reflector, the ophthalmoscopic apparatus comprises the lenses necessary to enable the observer to obtain a defined view of the different parts of the interior of the eye he wishes to examine,—especially a biconvex lens of two or three inches focus.

There are two modes of viewing the fundus of the eye with the ophthalmoscope. By the one, the objects are seen *erect* and much magnified; by the other, *inverted* and less magnified, though with a greater extent of field.

2nd. *Erect-image exploration.*

In this mode of viewing the *fundus oculi*, a deep concave glass is placed behind the reflector in front of the observer's eye, so that we have an optical combination similar to that of an opera-glass, the patient's eye being the object glass, and the concave lens the eye-piece.

It is generally better to place the concave lens between the *observer's eye* and the *reflector*, because, *cæteris paribus*, a larger portion of the patient's *fundus oculi* is illuminated. Besides, if the observer's eye is the more myopic, his maximum field of view (bounded by the margin of the patient's pupil) is larger when the lens is so placed than it is when the lens is placed between the reflector and the patient's eye.

The only case in which placing the concave lens in front of the reflector presents any real advantage is when the *patient's eye* is extremely *myopic*.

If it be the right eye we are about to examine with our right eye, we direct the patient to turn it towards his nose and upwards by looking at our right ear. If it be the left eye we are about to examine with our right eye, we direct him to look at our left ear.

We can thus look into the eye to be examined in a direction backwards and inwards. The papilla optica may perhaps present itself at once. More usually we catch with our eye one of the large retinal veins first; when by following this vessel to its trunk, the papilla optica will start into view.

In making the erect-image exploration, the observer has to look into the patient's eye from a very short distance.

The annexed diagram illustrates the course of the rays in the erect-image exploration from the patient's eye to that of the surgeon.

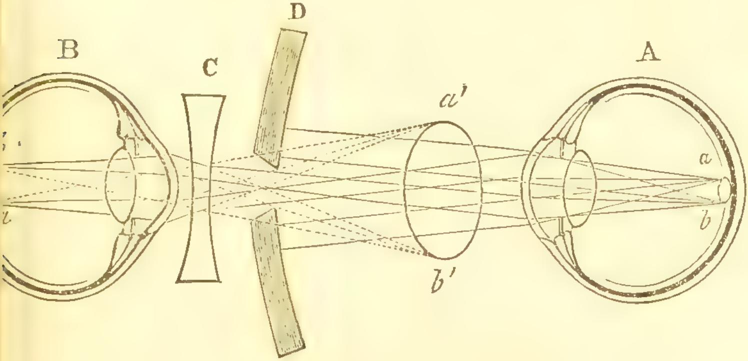

FIG. 10.

a b. The papilla optica of the patient's eye A. From *a* a pencil of light radiates, and on entering the air after emerging from the eye is refracted so as to become convergent. Those rays that pass through the aperture of the mirror, encountering the biconcave lens, are rendered divergent before entering the surgeon's eye B. Here they are converged and brought to a focus on his retina at *a*.

From *b* in the patient's eye A, a pencil of light radiates and follows a similar course, and some of its rays at last come to a focus on the retina of the surgeon's eye at *b*. The result is that an inverted image of the papilla optica of the patient's eye is impressed on the retina of the eye of the surgeon, who, therefore, sees projected out before him, in the direction of the axis, rays of the cones of light which make the impression, (and this although the axis rays do not themselves fall on the retina,) a virtual image, *a′ b′*, erect and magnified, of that object.

If the eye, under the influence of atropia, be *myopic*, the rays reflected from its fundus will, on entering the air, be convergent; if *hypermetropic*, the rays, on entering the air, will, on the contrary, be divergent; whilst, if *emmetropic*, they will, on entering the air, be parallel.

Hence the ophthalmoscopic observer, if he be myopic, or at least if his eye be adjusted for divergent rays, may be able to see an erect image of the fundus in the hypermetropic eye;* but to see the same in the emmetropic eye, he will require the aid of a concave glass; and to see the same in the myopic eye, a still stronger concave—stronger than that used by the patient.

The ophthalmoscopic observer, on the contrary, if his eye be hypermetropic, and in a state of relaxation as regards adjustment, will be able to see an erect image of the fundus in the myopic eye without assistance; but to see the same in the emmetropic eye he will require the aid of a convex glass to render the parallel rays convergent; and to see the same in the hypermetropic eye he will require a still stronger convex glass to render the divergent rays issuing from the eye under examination convergent.

The ophthalmoscopic observer, again, if he be emmetropic, and his eye be adjusted for parallel rays, will be able to see an erect image of the fundus in the emmetropic eye; but to see the same in the myopic eye he will require the aid of a concave glass to render the convergent rays issuing from the myopic eye parallel; and to see the same in the hypermetropic eye he will require the aid of a convergent glass to render the divergent rays issuing from the hypermetropic eye parallel.

3rd. *Inverted-image exploration.*

By interposing a convex lens of two or two and a half inches focal length at the distance of about two or two and a half inches in front of the patient's eye, an inverted image of the fundus is seen projected between the lens and the observer. In this case the patient's eye and the convex lens together form an optical combination similar to that of the object-glass of the compound microscope;

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* After the operation for cataract the eye is very hypermetropic. The fundus may, therefore, be seen erect without the assistance of a concave lens.

while the convex glass, of from twelve to eight inches focus behind the aperture of the reflector, is the eyepiece through which the inverted image is viewed. Usually an eyepiece is not necessary. Sometimes, however, the definition is much improved by the aid of a convex lens of from twelve to eight inches focus, as an eyepiece, slipped into the slot behind the aperture of the reflector. Such an eyepiece enables the observer to see the inverted image at a shorter distance, so that it presents a greater apparent magnitude.

Without the interposition of a convex lens in front of the eye, an inverted image of its fundus is projected out from it at the distance of the distinct vision of the patient. This may be seen by the observer looking through the aperture of the ophthalmoscope, at the distance of his own distinct vision from it. The distance between the *observer* and *observed* eye must in this case equal the sum of the distances from which these eyes are respectively adjusted. But such an image as that referred to is very indistinct.

If the patient's eye be myopic in a high degree, a sufficiently distinct inverted image of its fundus may, however, be seen projected in front of it without the interposition of a convex lens. This is owing to the rays being in a state of great convergence on issuing from such eyes, so that they quickly come to a focus, and form an inverted image, at a nearer distance, in front, from which the rays, having crossed, proceed divergingly to the observer's eye. When a convex glass is used in making the inverted-image exploration of a myopic eye, it should be of low power, otherwise the papilla will appear very small, though the field is large.

Fig. 11 shows the general arrangement in the inverted-image exploration.

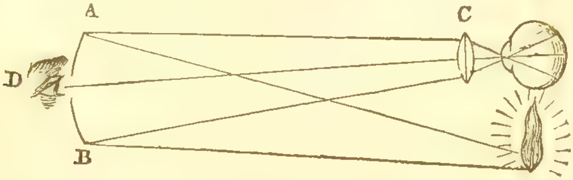

FIG. 11.

A B, reflecting mirror; C, convex lens in front of the patient's eye; D, the observer's eye. The rays from the flame being reflected by the concave mirror A B, fall in a state of convergence on the convex lens C, in front of the observed eye. By that lens the rays are so much more converged, that by the additional refraction they undergo on entering the eye, they quickly come to a focus, cross and fall in a state of dispersion on the fundus, so that this is extensively illuminated.

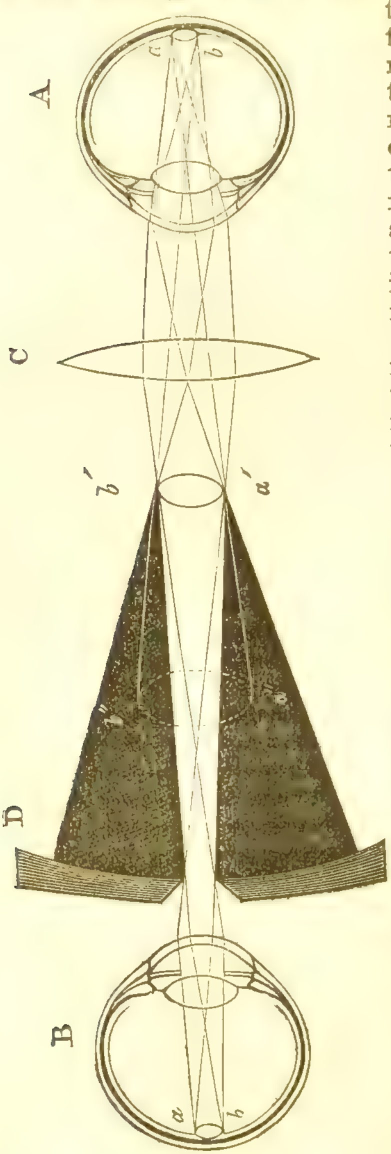

Fig. 12.

The annexed diagram illustrates the course of the rays in the inverted-image exploration from the patient's eye to that of the surgeon.

A, the patient's eye; B, the surgeon's eye; C, the convex lens held in front of the patient's eye; D, the reflecting mirror.

From the papilla optica in the patient's eye a pencil of light radiates from *a*, and on leaving the eye and entering the air becomes converged, and tends to a focus at *a″*. A similar pencil of light radiates from *b*, and following a similar course, tends to a focus at *b″*. A real inverted image, *a″ b″*, of the papilla optica of the patient's eye thus tends to be projected in the air. By the interposition of the convex lens the rays are more quickly brought to foci at *a′* and *b′*, where a well defined but smaller inverted image of the papilla optica of the patient's eye is projected.

The rays having formed the foci at *a′ b′*, and crossed, now proceed divergingly. Some of them, passing through the aperture of the mirror, enter the surgeon's eye, where they are brought to foci on his retina, *a b*.

The result is he sees the aerial image, *a′ b′*, which is an inverted and magnified image of the papilla optica of the patient's eye, just as the image seen in the compound microscope is an inverted and magnified image of the object under examination.

The weaker the convex glass held before the patient's eye the larger is the inverted image, but the field of view smaller.

In making an ophthalmoscopic examination it is best to have the room darkened. If necessary, an assistant may stand behind the patient to support and steady his head, and at the same time to keep the upper eyelid raised.

The patient's eye under examination should be shaded from the light by the intervention of a screen, or, what is simpler and answers very well, by his own hand open

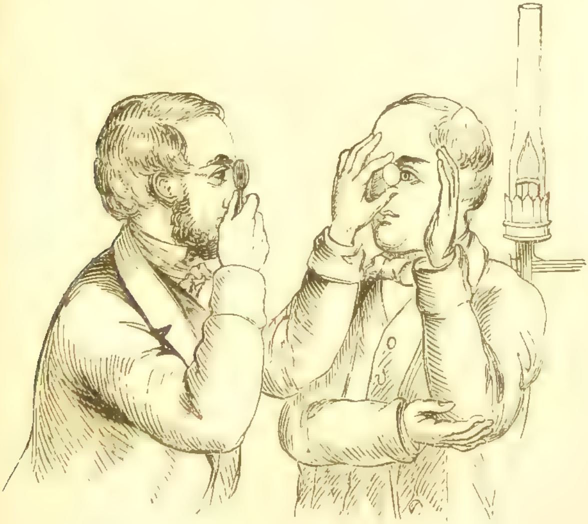

Fig. 13.

held up on his temple by the side of his eye, if it be the left eye which is under examination. When it is the right eye which is under examination, the surgeon can himself shade the light from the eye sufficiently well by means of his left hand, which holds the lens in front of the patient's eye.

The patient being seated, as before directed, with the light by the side of and a little behind his head, but on a level with his eye, the surgeon, with the reflecting mirror in one hand, and the strong convex lens in the other, if about to make the inverted-image exploration, stands or sits before the patient. (Fig 13.)

He then, holding the convex lens about two inches or so in front of the eye to be examined, looks through the aperture of the reflecting mirror, and rotates its handle at the same time, until it attains such an inclination that it reflects the light full into the pupil of the patient's eye.

By now making tentative movements of holding the mirror nearer or further off, or the lens nearer or further off, the surgeon at last gets them placed at the reciprocal distance which the circumstances of the particular case require.

An image of some part of the fundus of the eye thus comes into view, perhaps one of the large veins of the retina. This vessel being followed towards its trunk by looking in the apparently opposite direction, the observer's eye will hit upon the papilla optica. In seeking for the papilla optica, we direct the patient to turn his eye inwards, and somewhat upwards, in order that we may look through the outer third of the cornea in the direction of the prolonged axis of the optic nerve. If the papilla and vessels are not seen well defined, it may be necessary to place a convex lens of from 12 to 8 inches focus behind the aperture of the mirror. This, however, besides circumscribing the field of view as before mentioned, often interferes with the observation, inasmuch as the reflection from the patient's cornea of an image of the flame or reflector more readily comes to obstruct the centre of the pupil.

The great difficulty in using the hand-ophthalmoscope consists in properly combining the movements which it is necessary to give to the mirror and lens, in order to place them at the distance from each other, and from the eye under examination, required by the length of their foci, and that of the distinct vision of the patient and surgeon respectively. By practice we come at last to fulfil this complex condition after some manœuvres.

The simplest and best form of stand-ophthalmoscope I have met with is Liebreich's, as improved by Messrs. Smith, Beck & Beck, of Cornhill, according to the plan of Mr. Kilburn.

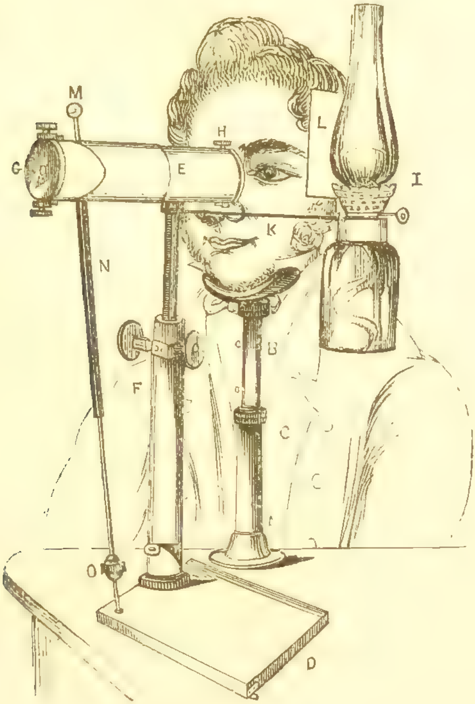

Fig. 14.

The instrument is represented in Figure 14. The chin-rest A is detached, and stands of itself on the table. Its height is regulated by a sliding tube B, which may be fixed in any position by the milled ring C.

The ophthalmoscope is mounted on a mahogany board D, which has three small rollers underneath, so that the instrument as a whole may be moved in a direct line, nearer or further from the eye, admitting at the same time any side movement that may be required, or a slight rotation which is sometimes necessary when light is reflected from the surface of the cornea.

The height of the horizontal tube E, carrying the mirror and the lens, is regulated by the milled heads F, connected with a rack and pinion. The mirror G is attached to an outside sliding tube, which, when in use, is drawn off about one inch from the upright stem; and the lens H is mounted upon a pin, so as, by rotation, to throw aside the reflexions from the surfaces of the glass.

The lamp I is attached to the stem of the ophthalmoscope by an arm K, which should, when in use, be at right angles to the horizontal tube. This arrangement is of great advantage, because the illumination will remain unaltered, however much the instrument may be moved about when the necessary adjustments are made.

A shade L fits in a hole near the lamp, to screen the light from the eye of the patient; and the object, upon which the eye to be examined must be fixed, consists of a small knob of ivory M, which can be moved in any direction by means of its sliding tube N, and the ball and socket joint O at its base.

The great recommendations of Mr. Kilburn's ophthalmoscope are, that it can be used standing at the corner of a table without any fixing, that the adjustments are easily and quickly made, and that its cost is very moderate.

The ophthalmoscope in its original form, as invented and brought into use by Professor Helmholtz, of Heidelberg, consisted of a reflector composed of four plates of glass laid one over the other without any aperture. The observer merely looked through the glass plates.

Here I ought not to omit stating that in the spring of the year 1847, Mr. Babbage showed me the model of an instrument which he had contrived for looking into the interior of the eye. The reflector was a small, plain glass mirror, with a part of the silvering rubbed off to look through.*

4th. *Exploration of the fundus of the eye under water.*

There is nothing more easy than to see the vessels of the retina in a cat's eye under water. Having previously dilated the pupil by atropia solution, drop some water into the eye while the eyelids are held apart, and cover the cornea with a thin plate of glass. The vessels of the retina can then be seen slightly magnified. It was long ago proposed by De la Hire to explore the bottom of the human eye in a similar manner. And of late years instruments have been contrived for the purpose, but the ophthalmoscope, as above described, is of more ready and convenient application.

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* See "British and Foreign Medico-Chirurgical Review" for October, 1854.

5th. *The fundus of the eyeball as seen on dissection.*

Preparatory to entering on the study of the morbid appearances presented by the fundus of the eyeball under ophthalmoscopic examination, it is necessary—1st, to call to mind the appearance of the fundus of the eyeball, as observed on dissection; and 2ndly, to make ourselves acquainted with the appearance of the fundus as seen in the healthy living eye by means of the ophthalmoscope.

If we divide the eyeball into an anterior and posterior segment, and examine the interior of the latter under water, we see the entrance of the optic nerve or papilla optica as a circular white spot, of about one-tenth of an inch in diameter, and from its centre the bloodvessels emerging, to ramify in a radiating manner on the inner surface of the retina. In such a dissection it is for the most part only the ramifications of the central veins of the retina that are seen, the ramifications of the central artery being, as is usually the case with small arteries after death, constricted, and empty of blood, and therefore not visible.

The expanse of the retina is seen at first to be transparent, so that the pigment membrane and vascular choroid shine through.

From near the temporal side of the papilla optica, extending transversely outwards for about one-fifth or one-sixth of an inch, the retina is always found on dissection raised into a small fold; but this, we shall see by ophthalmoscopic examination, does not exist in the living eye, and is therefore merely a *post-mortem* change.

In the same region of the retina, and at the point corresponding to the antero-posterior axis of the eyeball, about one-fifth of an inch to the temporal side of the papilla optica, and slightly below the level of the centre of the latter, the retina presents a clear point (*foramen centrale*), and is there for the extent of one-tenth of an inch all round of a yellow tinge (*limbus luteus foraminis centralis*).

6th. *The appearance of the fundus as seen in the healthy living eye by means of the ophthalmoscope.*

The red colour which the bottom of the eye presents varies in tint; being brighter in fair, more of a yellowish-brown in dark individuals. The papilla optica or entrance of the optic nerve appears as a whitish-gray and well-defined disc, from about the centre of which the retinal vessels are seen emerging to ramify on the red field. The retina in the situation of the yellow spot is little or not at all vascular, and sometimes presents a greenish-gray aspect. A streak of pigment deposit may be seen at some part or all round the border of the optic papilla.

The general redness of the fundus of the eyeball is owing to the vascular choroid shining through the pigment membrane and the transparent or nearly transparent retina. The finely granulated aspect which the surface presents, except at the entrance of the optic nerve, is communicated by reflection from the cells of the pigment membrane.

The clear orange-red tint of the fundus, as seen in the living eye under the ophthalmoscope, forms a striking contrast with the dark-brown colour presented by the fundus of an eye under dissection. The difference is owing to the quantity of blood circulating in the choroid, especially its inner capillary layer, in the living eye, and the absence of blood in the dead eye.

In persons of a dark complexion, the pigment membrane being very dark—its component hexagonal cells containing very dark pigment particles—imparts the dark hue to the redness of the choroid shining through it and the retina. The darkness of the membrana pigmenti, besides, prevents any of the individual vessels of the choroid from being distinctly seen.

In fair persons the membrana pigmenti is very light in tint, its component hexagonal cells containing light-coloured particles. The subjacent choroid, therefore, shines through of a bright colour, and the ramifications of its vessels may even be seen.

Interspersed in the stroma or substance of the choroid among its bloodvessels are pigment cells of variously irregular shape.

The pigment of these pigment cells of the stroma of the choroid varies in darkness, like the pigment of the pigment membrane, according to the complexion.

When the pigment of the stroma is light, as well as that of the membrana pigmenti, all the choroidal vessels can be distinguished—the small arteries as they proceed to the capillary network inside, and the vorticose veins behind.

When the pigmentation of the stroma is deeper, though the membrana pigmenti be light-tinted, the finer vessels of the choroid cannot be distinguished. The trunks of the choroidal vessels only are seen, with intervening dark spaces between them, giving the fundus a streaked appearance.

Suppose it be the left eye that is under examination, and that the image is inverted, the objects of the fundus are seen as follows:—

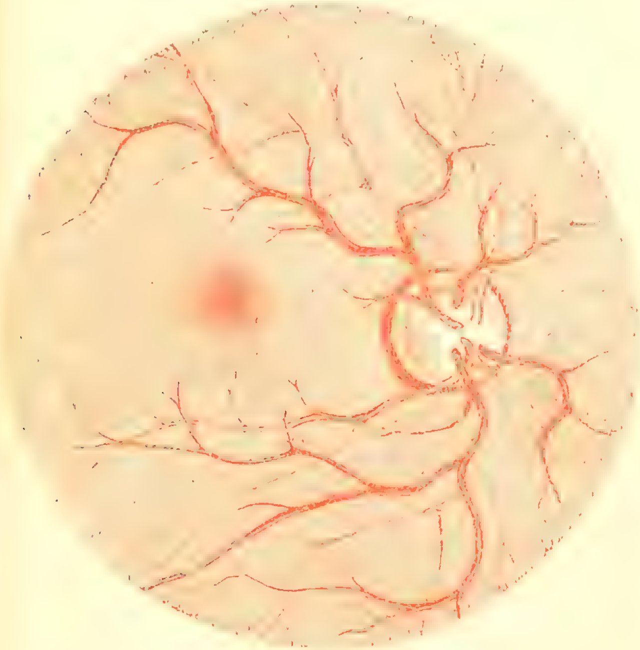

Fig. 15.

Papilla optica.—In the general red field of the fundus, the papilla optica, or entrance of the optic nerve, presents itself in the form of a whitish-gray disk, more or less circular, and about a quarter of an inch in diameter, from about the centre of which the trunks of the retinal vessels are seen to emerge, and proceed in a radiating direction to ramify on the retina.

The papilla varies somewhat in size, and has sometimes an oval outline, the long diameter being more or less vertical.

The proper boundary of the nervous substance of the papilla is indicated by a fine grayish line. Outside this, the sclerotic boundary shines through the retina as a narrow white crescentic line, apparently on the side opposite that from which the light enters. Outside the sclerotic boundary, again, there is a semicircular border of pigment which is that of the adjacent part of the choroid shining through the retina.

The colour of the papilla is whitish-gray in comparison with the general red field of the fundus, but it has a tinge of yellow or red.

From the centre of the papilla usually, though sometimes to the nasal side of the centre—rarely to the temporal side—the vascular trunks are seen emerging to ramify on the surface of the retina in a radiating manner towards the ora serrata. The retina being transparent, the vessels appear as if ramifying on the general red surface of the fundus.

The retinal arteries and veins.—The arterial trunks and ramifications are of a paler red colour, narrower in diameter and straighter in their course than the veins. The veins and their ramifications being dark red, thick and rather tortuous.

The central artery, as it emerges from the centre of the papilla, divides into two trunks, an upper and a lower, each of which again subdivides into two or three branches.

Each of the trunks into which the central artery divides is accompanied by two veins.

The arteries and veins may emerge from the papilla together or separately—sometimes each vessel has its own place of emergence.

Pulsations of the retinal vessels as seen during ophthalmoscopical examinations.—In the healthy eye pulsation of the arterial trunk is observed only when the globe is pressed on. It is characterised, like that of other small arteries, by a rapid undulatory progressive dilatation at the time of the systole of the heart, followed by constriction at the time of the diastole.

What is called the venous pulse may be seen without pressure on the eyeball, though by this it is rendered more evident. It is characterised by distension during expiration, and collapse during inspiration. At the time of the heart's systole there is a rapid progressive collapse or narrowing of the venous trunk proceeding in the direction from the centre to the periphery; and at the time of the heart's diastole, a slow dilatation proceeding in the opposite direction. This alternating collapse and distension of the venous trunks is owing to the circumstance that, during the diastole of the heart the re-action of the arterial walls drives the blood into the veins, which thus become at that time distended or widened from radicles to trunk. During the systole of the heart, on the contrary, the arteries themselves becoming distended with blood by yielding of their walls, less blood is driven into the venous radicles, from which, at the same time, the blood is being drained away into the trunks, and so the narrowing or collapse of the veins at the moment in question appears to take place progressively from trunk to radicles.

Ramifications of the retinal vessels.—Of the branches of the central artery of the retina, one from the upper and one from the lower trunk ramify on the temporal half of the retina at some distance above and below the yellow spot and foramen centrale. This part of the retina is pervaded by small vessels only.

Of the other branches from the upper trunk, one ramifies upwards and another inwards.

Of the other branches from the lower trunk, one ramifies downwards and another inwards.

The distribution of the corresponding veins is in the same general direction as that of the arteries, though the two sets of vessels do not closely accompany each other.

The small proper vessels of the papilla optica do not appear to arise from the central trunks and ramify towards the circumference, but, on the contrary, are derived from the smaller branches, distributed to the adjacent part of the retina, and ramify on the papilla from circumference to centre. In the state of congestion the papilla may sometimes be seen quite red, with the exception of a small spot in the centre, where the trunks are seen emerging, and which is slightly excavated.

Some degree of excavation of the papilla optica may be met with in quite healthy eyes. But such excavation of the papilla cannot be confounded with the deep excavation with overlapping edges and peculiar course of the trunks of the retinal vessels seen in glaucoma.

Macula lutea and foramen centrale.—While the patient looks straight forward at the image of the flame in the mirror, the *macula lutea* and *foramen centrale* present themselves to the eye of the observer. They are seated, as above mentioned, on the temporal side of the papilla, at a distance about double the diameter of the latter. The image being reversed, however, as above supposed, the macula lutea and central foramen appear to the nasal side of the papilla in our examination.

In consequence of the yellow colouration of the retina, and sometimes from the presence of a darker pigment behind it at the place, the redness of the choroid shines through the retina in the region of the yellow spot of a deeper tint. The foramen centrale appears as a bright point in the middle of this dark-red looking part. It is generally, at least in the emmetropic eye, on a slightly lower level than the centre of the papilla, and is therefore in the inverted-image examination apparently on a slightly higher level.

No vessels of any size ramify on the retina in the region of the yellow spot, as already remarked.

7th. *Morbid appearances which may be presented by the fundus of the eyeball under ophthalmoscopic examination.**

Whilst the morbid states of the anterior segment of the eyeball are sufficiently accessible to objective exploration, those of the posterior segment comprising the vitreous body, retina, and choroid, were formerly, with some exceptions, so far as regarded their actual nature, merely matters of inference. The exceptions were:—Exuded matter, &c., in the vitreous body, the retina bulged forward by fluid between it and the choroid, scrofulous and encephaloid growths at the bottom of the eye, &c., which give rise to a yellow shining appearance, sometimes traversed by bloodvessels, objects, which on account of

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* On this subject Dr. Liebreich's Atlas der Ophthalmoscopie is especially to be recommended.

their position being so much in front of the focus of the eyeball, admitted of examination by oblique illumination. Having determined that the disease was not seated in the anterior segment, and thus *per exclusionem*, and from the nature of the subjective symptoms (together with the objective symptoms presented by the anterior segment, and by the eye considered as a whole) we referred it to some part of the posterior segment.

Now, however, it is possible by means of the ophthalmoscope to observe morbid appearances at the fundus of the eye, as effectually as we can those at the anterior surface.

Papilla optica.—In making an ophthalmoscopic exploration of the fundus of the eye, in order to ascertain if there be anything morbid, it is best to begin with an examination of the *papilla optica.*

This may be found reddish from hyperemia or vascular congestion, except perhaps towards the centre where the retinal vessels emerge. Sometimes the papilla and retina are together inflamed, and the former is so much obscured by the inflammatory injection, as to be scarcely distinguishable from the latter, except by the radiation of the trunks of the retinal vessels from its centre. Sometimes, again, opacity from exudation confounds the boundary between the papilla and retina, whilst in consequence of

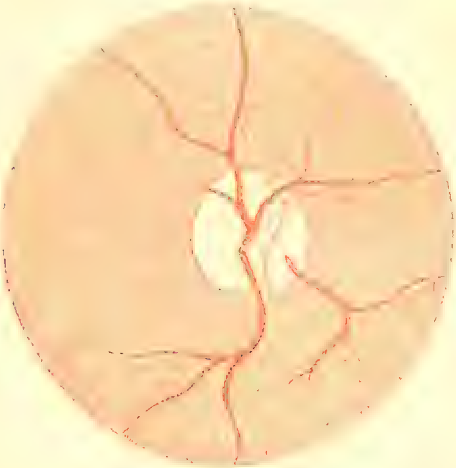

FIG. 16.

atrophy of the vessels, their radiation is liable to be overlooked. The papilla may be found to be the seat of points of extravasation of blood or of pigment deposits.

In some cases of amaurosis, the papilla presents a white tendinous aspect. This indicates atrophy from implication of the optic nerve in intracranial or intraorbital disease. The retinal vessels are much diminished in size, and along with the white aspect there is sometimes a cupped or excavated condition of the surface of the papilla. (Fig. 16.)

In glaucoma, excavation of the papilla optica occurs of a very remarkable character. The border of the papilla is so overlapped by its sclerotic boundary that the trunks of the retinal vessels (the veins turgid and dark, the arteries small and pale) are, towards the border of the papilla, covered from view, and when they reappear on the retina do not look like continuations of the same vessels. (Fig. 17.)

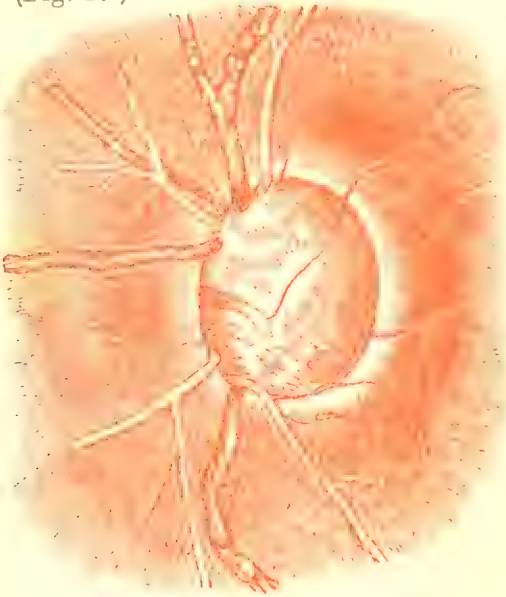

Fig. 17. (From Liebreich.)

This peculiar excavation of the papilla optica in glaucoma is considered to be the result of intraocular distension, as well as atrophy of the optic nerve.

Morbid prominence, with reddish-gray opacity, and undefined outline of the papilla optica, indicate infiltration of the interstices of the optic nerve from inflammatory exudation.

In determining whether prominence or excavation exists, it is to be remembered that to a single eye, an object viewed under conditions similar to those under which the papilla is seen with the ophthalmoscope, may appear as if in relief, when in reality it is in *intaglio*. The binocular ophthalmoscope obviates any such mistake.

Retina.—The principal morbid appearances in the retina which may be observed are congestions, spots of extravasated blood, exudations, pigment deposits, opacities of various aspect, the retina itself bulged forward in folds by fluid accumulated between it and the choroid, and tremulous in the dissolved vitreous body. On the bulging retina the bloodvessels are seen ramifying.

In examining opaque deposits at the bottom of the eye it is necessary to notice whether the retinal vessels ramify in front of them, or are concealed behind them, or are themselves atrophic.

Extravasations of blood, varying in size from small points of ecchymosis to considerable patches, may present themselves. Their seat may be between the choroid and retina, or in the retina itself, or on its surface. Retinal extravasations are seen usually in the region around the papilla, and in the course of venous ramifications. Extensive extravasations—often occurring suddenly in cases of heart disease—constitute what has been called *apoplexy* of the retina.

Reddish-gray opacity of the papilla, and well-defined white patches of the retina all round, interspersed with spots of extravasation, the retinal vessels being distinctly seen on the surface, are appearances indicative of the fatty degeneration of the retina, characteristic of the existence of Bright's disease of the kidneys. (Fig. 18.)

Dull diffused opacity of the papilla and retina, extending in the direction of some of the large vessels, and around the macula lutea; the veins that are visible, large, the arteries, small; or, what eventually occurs, both sets of vessels, along with the retina, atrophic. Such are the appearances met with in cases of syphilitic retinitis.

A pale tint of the fundus—the retinal veins, though large and tortuous, especially pale—points of extravasation pale—the papilla pale with streaks of retinal opacity extending from it—spots of opacity in the region of the macula lutea. Such are appearances described by Dr. Liebreich as characteristic of what he calls *leukaemic retinitis.*

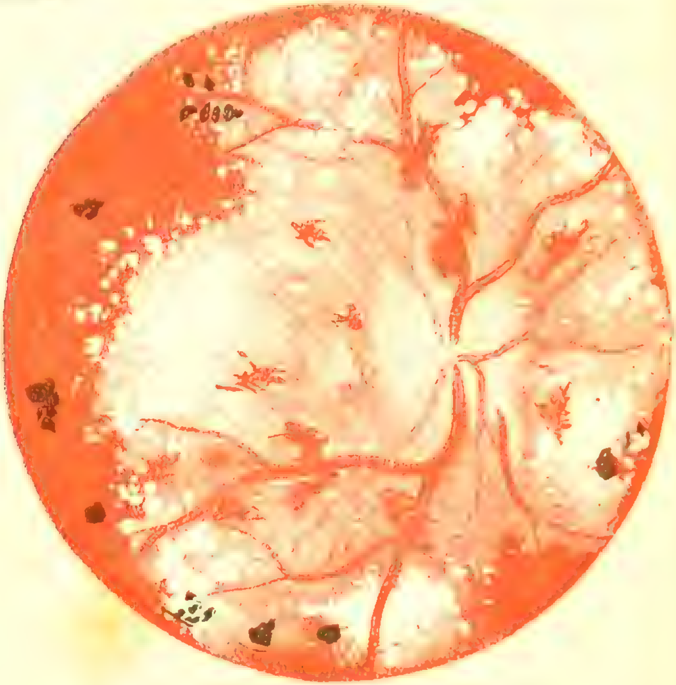

FIG. 18.

Pigmentous degeneration of the retina. — Many years ago I had, by the favour of Dr. Mackenzie, the opportunity of dissecting the eyes taken from the body of a young man who was deaf and dumb, and had been affected with night-blindness from childhood. The retina, especially on the outside, I found dotted all over with pigment deposits. The ophthalmoscopic appearances in such a case have been found by Dr. Liebreich to be as follows:—Irregular black spots scattered over the fundus of the eye; the papilla atrophic and white, sometimes well defined, sometimes ill defined, and perhaps oval or triangular in shape; the vessels small and in advanced cases obliterated; the choroid sometimes shining through in a morbid state.

This affection of the retina does not at first affect the centre, so that the sight may be still good for the middle of the field. In consequence of contraction of the field, the patient finds it more easy to read small print than large, as he can take in more words of small print at one time.

Whitish opacity of the retina in the course of the great vessels, all of which are quite distinct at the surface. The opacity extending insensibly over the papilla so as to render it scarcely distinguishable except by the position of the point of radiation of the retinal vessels. Irregular pigmentation of the choroid shining through the unaffected part of the retina. Such appearances indicate *choroido-retinitis.*

Choroid.—The choroid may be found the seat of inflammatory congestion in various degrees, of different kinds of exudation, and of degeneration and atrophy. The pigmentation is often altered both in respect to the cells of the pigment membrane and those of the stroma of the choroid itself. The pigment membrane being broken up and the stromatic pigment increased, the larger choroidal vessels are seen at the place with dark intervening spaces.

In inflammation of the choroid, the fundus of the eye may appear dark red like a much inflamed conjunctiva.

The aspects under which the exudation presents itself are chiefly:—

White patches behind the retinal vessels disseminated over the fundus of the eye, interspersed with spots of pigment, as in disseminated choroiditis.

Small white patches, but more numerous and without any tendency to coalesce, as in syphilitic choroiditis. In such cases there may be a shrunken state of the papilla and small size or obliteration of the vessels emerging from it indicative of atrophy of the retina and optic nerve.

A circumscribed elevated patch of whiteness with retinal vessels over it.

Separation of the retina from the choroid by serous effusion between the two membranes.—If the fluid be clear and colourless, the retina, which is pushed forward, and undulating, in the vitreous humour dissolved and diminished in quantity, is recognised by the white contours of the folds into which it is thrown, and the dark-coloured veins coursing on its surface. If the effused fluid be opaque, the retina appears of a bluish gray. It is the lower half of the retina which is most commonly found detached. In more advanced cases the detachment extends upwards on either side of the papilla. The inner and upper parts of the retina remain longer unaffected. Visual sensibility may be still possessed by the undetached portion of the retina. (Fig. 19.)

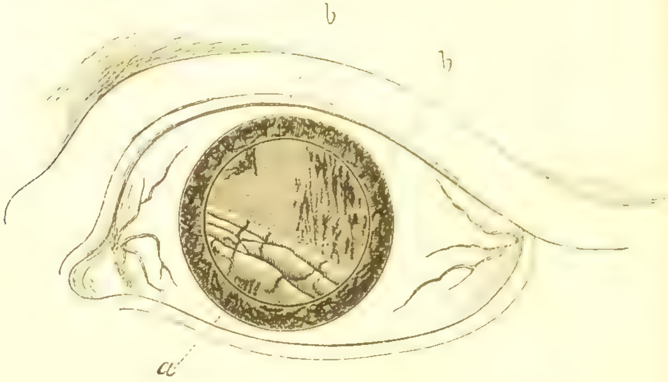

Fig. 19. (From Jäger.)

a. The bulging retina. *b b.* Deposits of pigment.

The yellowish reflection from the fundus visible to the unassisted eye of the observer, in the cases which have been named *amaurotic cat's eye*, is owing to yellowish gelatinous exudation on the inner surface of the choroid pushing the retina forwards.

Tumours at the bottom of the eye.—A small, sharply defined yellow tumour protruding forward in the vitreous humour with the retina and its vessels before it. Such is an appearance which calls upon the surgeon to endeavour to decide whether it is owing to solid exudation between the sclerotica and choroid, or to tuberculous or encephaloid deposit in the choroid itself.

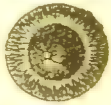

Fig. 20.

Encephaloid tumour is of most common occurrence in infants or very young children. As it increases in size and advances forward it becomes an object for examination by oblique illumination, and appears as a yellow tumour with vessels running over it. The eyeball becomes more and more distended, hard, and painful.

The pupil is at an early period much dilated, and the iris becomes pressed forward. By the pressure of the tumour on the lens this becomes opaque, and the case is no longer one for ophthalmoscopical exploration.

Tumours from tuberculous deposit in the choroid are usually met with in children a little older than those in whom encephaloid occurs.

Tumour from exudation between the sclerotica and choroid, which is rare, has been found chiefly in grown-up persons.

Cysticercus cellulosæ behind the retina.—The appearance which has been observed at the bottom of the eye in such a case is that of a greenish-gray cyst, over which retinal vessels ramify, and in the interior of which is seen, near its periphery, a second very delicate round contour, that of the vesicular tail; and towards the centre an opaque yellowish spot, which, during the movements of the animal, is recognised as the neck and head. The movements consist in an undulatory contraction and dilatation of the vesicle, in which it loses its regular form, and the head alternately appears more distinctly or more indistinctly; at other times, in bendings of the neck and head. The hydatid, it has been found, may break hrough the retina, and come to lie in the vitreous humour. Here it is at first distinctly recognised; not only the head, which is now retracted, now protruded, but also the suckers are seen. Eventually, however, opacity of the hyaloid, and formation of false membranes around it supervening, further observation is prevented.

Exposed sclerotica.—White patches at the bottom of the eye may be owing to the sclerotica being exposed in conequence of atrophy or laceration of the choroid.

An officer in the Crimea was struck on the temple by a plinter of a shell. When he recovered himself, he found he was blind of the eye on the corresponding side. On examination of the fundus of the eye with the ophthalmoscope after his return to England, I discovered the white surface of the sclerotica exposed through a transverse laceration of both the retina and choroid. The acerated edges were reddish, as if from extravasated lood. About a year after that they were found to be icatrised, and the seat of pigment deposits.

In posterior sclerotic staphyloma, a subjective symptom f which is myopia, the characteristic ophthalmoscopic appearance, we shall see, is a crescentic patch of whiteness, embracing in its concavity the papilla, usually at the temporal and lower side. This appearance is owing to the white sclerotic shining through, in consequence of the atrophied condition of the choroid at the place. Sometimes in posterior sclerotic staphyloma the papilla optica appears of an oval form, partly in consequence of a real alteration in shape, and partly in consequence of its having become so displaced as to be seen obliquely; the alteration in shape and the displacement both being the effect of its implication in the staphylomatous bulging. Under such circumstances the crescentic patch of white sclerotica forming with the oval papilla a somewhat circular outline like that of the normal papilla, the nature of the case is liable to be overlooked on a hasty examination. (Fig. 21.)

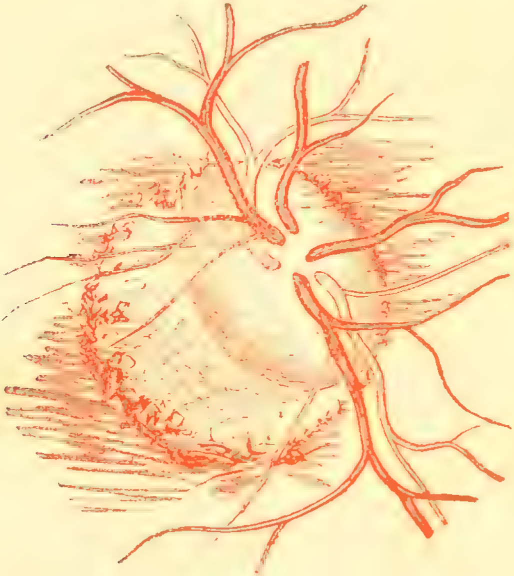

Fig. 21.

Vitreous body.—Morbid states discoverable in the vitreous body are extravasations, exudations, opacities in the form of fixed spots, or of undulating membraneous shreds and filaments, of the most different size and form, with sharp or indistinct outline, sparkling cholesterine crystals, supported on filaments or membraneous surfaces. Opaque bodies in the vitreous look black, as we have seen streaks of opacity in the lens do.

Objects in the vitreous body being in front of the focus of the dioptric media of the eye, admit of being seen erect without the assistance of a concave glass. They may even be examined without the ophthalmoscope by oblique illumination, and with the help of a convex lens.

Conical cornea. Suppose a case of conical cornea in which the deformation has not been noticed in the ordinary way, and in which an ophthalmoscopical examination of the eye is had recourse to in order to ascertain if there is any morbid condition of the fundus to account for the defective sight, the following appearances will, according to Dr. Donders, indicate the nature of the case. In the inverted image, where there is a pretty wide pupil, we have a view of a rather large portion of the fundus oculi; the image, therefore, of one part or other, of the papilla optica for example, remains in the field of vision both on moving the head of the observer, and on shifting the lens held before the observed eye. At he same time, however, the rays, which proceed from he papilla optica and strike the eye of the observer, pass each time through other parts of the cornea; now if its curvature is irregular, the result is that the focus of the papilla each time alters, that it shortens in this direction, extends in that; and, moreover, is never seen distinctly n its integrity. In somewhat higher degrees, too, the ide of the conical projection opposite to the incidence of he light is darker, as if shaded.

§ III. SUBJECTIVE EXAMINATION OF THE EYE.

1st. *Pain; its seat and character.*

Pain in and around the eye, of various kinds and egrees, attends many diseases of that organ, especially he ophthalmiæ. It is, however, not a constant symp-om; cases of the most intense inflammation, for example, re met, in which no complaint of pain is made. Speak-ng generally, however, it may be said that pain, as if a oreign body were in the eye, with heat, itchiness, and marting of the edges of the eyelids, and sometimes pain cross the forehead, indicates conjunctival inflammation.

Rheumatic pain around the orbit, or in the temples, occurring in nocturnal paroxysms, points to inflammatory congestion of the sclerotica, iritis, &c. Deep-seated distending pain in the eyeball, with or without circumorbital or temporal pain, or pain extending to the back of the head, marks posterior internal inflammation of the eye.

Such pains are to be distinguished from neuralgia of some one of the branches of the ophthalmic division of the fifth nerve. In neuralgia, there may be symptoms of congestion, but they intermit along with the paroxysm.

2nd. *Impairment or loss of common sensibility.*

The common sensibility of the conjunctiva, skin of the eyelids, &c., to the contact of external objects, may be found impaired or lost. Notwithstanding, the patient may have the sensation of creeping or formication, or may actually suffer neuralgic pains (*anæsthesia dolorosa*). When insensible to the touch, the eyes feel cold.

3rd. *Intolerance of light, or photophobia.*

Intolerance of light, in a greater or less degree, is a very frequent symptom in the ophthalmiæ; but that in which it occurs most intensely is the scrofulous ophthalmia of children. Intolerance of light may also occur in other affections not coming under the head of the ophthalmiæ. The indication of intolerance of light by the general bearing of the patient has been above (p. 2) noticed.

4th. *State of vision.*

In our inquiries as to the state of vision, it is necessary to bear in mind that the anomalies complained of may depend—some, on derangement of the dioptric apparatus of the eye; some, on loss of correspondence in the direction and movements of the two eyes; and some, on affection of the optic nervous apparatus.

Myopia.—The surgeon should have a series of concave glasses with which to test the sight when complaint is made that objects at some distance cannot be seen distinctly, as in *myopia* or shortsightedness.

In myopia, the distance at which the retina is seated behind the lens is greater than in the normal or emmetropic eye. Therefore the rays of light from distant objects, unless they be rendered divergent by the interposition of a concave lens, come to a focus before reaching the retina, and the objects are therefore not distinctly seen. The abnormally increased distance of the retina behind the lens, is, especially in high degrees of myopia, owing to bulging out of the back of the eyeball from posterior sclerotic staphyloma. (See p. 60.)

It is sometimes necessary to determine whether in a given case there be shortsightedness at all; in short, whether or not the case be one of feigning.

All doubt may be removed if, by ophthalmoscopic exploration, the surgeon detects the existence of posterior sclerotic staphyloma, or that the rays of light reflected from the eye, while under the influence of atropia, enter he air in a state of convergence. (See *supra*, p. 40.)

Another plan is to try whether the person can read niddle-sized print with such deep concaves as Nos. 6 and .0. If he can do so he must be short-sighted. But in iddition to this test it may be useful to try the person urther, by requesting him to read now with concave, iow with convex glasses, without of course letting him now the difference, and noting the consistency or inconistency of his answers to the question—how he sees with hem ?

Presbyopia with farsightedness.—The surgeon should ave also a series of convex glasses with which to test the ight when the complaint is that in reading or sewing the ight is indistinct, unless the book or seam be held at rm's length, as in presbyopia with farsightedness. This irsightedness is owing to diminution or loss of the ower of adjusting the eye for near objects—a change hich naturally occurs with the advance of life—the eyeall being emmetropic or normally proportioned, and herwise sound.

When, with the advance of life, a person who has lways been somewhat myopic or shortsighted, loses the ower of adjusting the eye for distances, in other words comes *presbyopic*, he can see distinctly neither so near s he used to do, nor perhaps so far off. In such a case nvex glasses will be required for reading with, and ncave glasses for viewing distant objects.

Hypermetropia.—In some cases the patient requires the lp of convex glasses to see even distant objects, withit an exertion of his near-adjusting apparatus. In this ndition of the eye, which has been named hypermetropia, and which is the reverse of myopia, the retina is seated at too short a distance behind the crystalline lens; so that not only the divergent rays of light from near objects, but even the parallel rays from distant objects tend to come to a focus only behind the retina, unless first rendered convergent by the interposition of a convex lens. By great exertion of the near adjusting apparatus, even rays of light from near objects may indeed be brought to foci on the retina, but the exertion cannot usually be kept up long. The adjustment fails from fatigue, and the sight becomes confused.

In thus exerting the near adjusting apparatus, the eyes are at the same time much converged. In some cases of hypermetropia the patient appears to be unable to graduate the convergence and adjustment. In reading, for instance, he converges the eyes, and exerts the near adjustment to such a degree, that the book requires to be held quite close to his eyes, so that he appears to be affected with myopia instead of hypermetropia—the converse condition of sight.

In consequence of the nearness at which the book is held to the eyes, one of them only can be fixed on it; the other squints inwards. Convex glasses, by rendering the excessive exertion of the near adjustment with great convergence unnecessary, enables the patient to read at an ordinary distance, and diminishes or corrects the tendency to squint.

Patients are sometimes met with, whose one eye is myopic and the other hypermetropic. One gentleman thus affected had divergent squint; another had convergent squint. The former gentleman used his myopic eye for reading with, the hypermetropic eye for looking about with. The latter gentleman used his myopic eye for both purposes, until the sight of it was lost from serous effusion between the choroid and retina; when, being fitted with suitable convex glasses, his hypermetropic eye became available for reading as well as looking about with.

When, with the advance of life the adjusting power is lost, the hypermetropic eye cannot see distinctly at any distance, but requires, like a person who has undergone the operation for cataract, convex glasses of a lower power for viewing distant objects, and convex glasses of a higher power for reading or sewing.

Asthenopia.—A not unfrequent defect of sight among young persons and even children is, that though in commencing to read or sew the sight is quite distinct, the eyes become fatigued in a few minutes, and everything appears confused (*asthenopia*). In such a case, convex glasses enable the person to exercise vision on near objects without fatigue.

The vision for distant objects is usually not complained of. Eyes which suffer in this manner have the hypermetropic conformation, and the asthenopia is owing to the weakness of the adjusting apparatus.

One form of asthenopia, however, depends merely on inability to maintain the eyes converged in consequence of weakness of the internal recti muscles.

Astigmatism.—The surgeon should also have a series of cylindrical lenses—both convex and concave—to test the sight for *astigmatism.* This, in its most ordinary form, consists in the eye seeing horizontal lines distinctly at a nearer distance than vertical lines, so that in looking at a watch with Roman numerals, for example, the person sees the IX and the III more distinctly than the XII and the VI, whilst at a farther distance he sees the XII and the VI more distinctly. If the astigmatism be slight, vision is not materially disturbed, but if it be in any great degree, the indistinctness of sight is so great as to require the help of cylindrical glasses.

A concave cylindrical glass of suitable power, with its axis horizontal, held before the eye, will enable the person to see the IX and the III distinctly at the same distance as he naturally sees the XII and the VI, so that he will now be able to see the figures on the face of the watch equally distinctly all round.

A convex cylindrical lens of suitable power, on the other hand, with its axis vertical, will enable the person o see the XII and the VI distinctly at the same distance s he naturally sees the IX and the III, so that he will now be able to see the figures on the face of the watch qually distinctly all round.

Professor Stokes has invented an instrument for testing he degree of astigmatism with which the eyes may be ffected without the necessity of having at hand a whole eries of cylindrical lenses.

The following is Professor Stokes' description of the nstrument:—

If two plano-cylindrical lenses of equal radius, one concave, and the other convex, be fixed, one in the lid, and the other in the body of a small round box, with a hole in the top and bottom, so as to be as nearly as possible in contact; the lenses will neutralise each other when the axes of the surfaces are parallel; and by merely turning the lid round, an astigmatic lens may be formed, of a power varying continuously from zero to twice the astigmatic power of either lens. When a person who has the defect in question has turned the lid till the power suits his eye, an extremely simple numerical calculation, the data for which are furnished by the chord of double the angle through which the lid has been turned, enables him to calculate the curvature of the cylindrical surface of a lens for a pair of spectacles which will correct the defect of his eye.

In using the instrument the lenses are first set at some angle for trial, and the lens is then applied to the eye, and turned round as a whole about the axis of the eye, till the vision is most distinct. There are two positions, 180° apart, in which the vision is most distinct, while in the intermediate positions, distant 90° and 270° from the first, it is worst. One of the best positions having been found, and the degree of distinctness noticed, the angle between the lenses is to be slightly varied, by turning the lid alone, and the observation repeated, and so on till the adjustment is complete. The position of the lid relatively to the body of the box having been noted, the lid is to be turned till the axes of the lenses are parallel, or, what is better, turned through this position to nearly an equal angle on the opposite side, the exact angle being found by trial as before.

A fine circle, such as may be found in mathematical plates, or a series of fine straight lines, drawn in all directions through a point, forms a good test object. The different parts of the circumference, or the different lines of the series, ought all to be equally distinct. A page of small Greek print forms also a good object.*

Test-letters for ascertaining the degree of distinctness of sight.†—In order to ascertain the degree of distinctness of sight, Dr. Snellen, of Utrecht, measures the smallest angle at which objects of known size and form can be distinguished. Visual angles are determined by measuring the extreme distance at which objects of definite size, such as letters, can be recognised, or by measuring the size of the objects which can be distinguished when placed at a definite distance, say one foot.

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* Report of the British Association for 1849, Part II., p. 10.

† "Test Types for the Determination of the Acuteness of Vision," Utrecht, 1862.

The following sizes of letters correspond sufficiently nearly to those given by Dr. Snellen, as seen by a normal eye at an angle of five minutes (5′) from the distance in feet, indicated by the numbers marked over them respectively.

If a person sees No. I. at one foot, No. II. at two feet, and cannot see No. XX. at twenty feet distance, myopia exists. If, on the contrary, he sees No. XX. at twenty feet, and does not see No. I. at the distance of one foot, the nearest point of vision lies at more than one foot from the eye.

The degree of acuteness of vision (V) is expressed by the relation of the distance at which the letter is actually seen (d), to that at which the letter is apparent at an angle of five minutes (D, the distance in feet marked over the letters) by a normal eye:—

$$V = \frac{d}{D}$$

If d and D be found equal, and No. XX. be thus visible at a distance of twenty feet, then test-letters $= \frac{20}{20} = 1$; n other words, there is normal acuteness of sight. If, on he contrary, d be less than D, and if No. XX. is visible only at ten feet, No. X. only at two, and No. V. only at one foot, these three cases are thus expressed respectively:—

$$V = \frac{10}{20} = \frac{1}{2},$$
$$V = \frac{2}{10} = \frac{1}{5},$$
$$V = \frac{1}{6}.$$

d may sometimes be greater than D, and No. XX. be hus visible at a greater distance than twenty feet. In uch a case, vision is more acute than the normal range.

Perfect acuteness of vision occurs only with exact accommodation for the given distance.

Since the distinctness of vision within the limits of ccommodation is necessarily the same for every number, t follows that experiments with letters of different sizes, laced at appropriate distances, supply a test of the accuacy of the patient's statements, and insure the detection f attempts on his part to simulate, exaggerate, or issemble:—

I.

n p r t v z b d f h k o 1

II.

F H K O S U Y A C E G L 2

III.

C E G L N P R T V Z B D 3

IV.

V Z B D F H K O S U Y A 4

V.

I U Y A C E G L N P R T 5

VI.

N P R T V Z B D F H K O 6

VII.

F H K O S U Y A C E G L 7

VIII.

C E G L N P R T V Z B D 8

X.

V Z B D F H K O 10

XII.

I U Y A C E G 12

XV.

N P R T V S B 15

XX.

U Y A E C 20

In *amblyopia*, or defective sight from affection of the optic nervous apparatus, although neither distant nor near objects are seen distinctly, the latter may be seen better than the former, because they are seen larger, just as in bad light we can see large print better than small. Such a case, which may be called nervous shortsightedness, must be distinguished from true or optical shortsightedness. In nervous shortsightedness the sight will probably be improved, not by a concave, but by a convex glass, which magnifies the object.

When a young person, though he does not see near objects very distinctly, complains chiefly that he cannot see distant objects well; and if on trial it is found that the sight is not assisted by concave glasses, an examination of the form of the cornea, whether it be conical, and of the state of the lens, whether its transparency be impaired, should be instituted.

In conical cornea, which constitutes a different form of astigmatism from that above noticed, the sight is short, and is, in an early stage, assisted by a concave lens, but the rays of light not being all brought to one focus on the retina, it is at the same time very confused. In a case of opacity of the lens, referred to as being likely to be the cause of the apparent shortsightedness, the sight for near objects is somewhat improved by a convex glass, because the objects are thereby magnified.

Mydriasis.—In a case of indistinctness of sight, with the pupil greatly dilated, the patient should be requested to look through a small aperture made with a thick pin in a card or an instrument kept for the purpose, such as is represented in Figure 22. If objects are then seen distinctly, the case is one of simple *mydriasis*, the eye being probably at the same time in its lowest state of refractive adjustment. In such a case a convex lens will enable the patient to read.

By looking through a small aperture, the circumferential rays of the cones of light are cut off. The central rays alone entering the eye, and passing through the central part of the crystalline lens, suffer little or no refraction, so that the eye is reduced nearly to the state of a simple camera obscura without a lens, in which a well-defined, though faint image is projected, independently of focus or adjustment. Brewster's theoretically best form of camera.

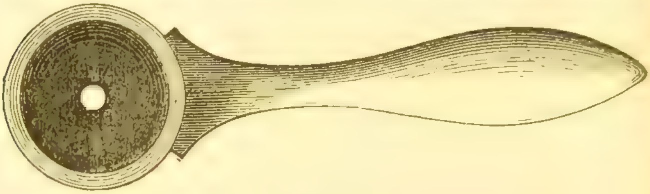

FIG. 22.

Donders' stenopæic apparatus.—The small aperture for looking through being its essential part, the instrument above delineated comes under the denomination of *stenopæic* (from στενός, *narrow*, and ὀπή, a *peephole*). This name Dr. Donders has coined to designate spectacles which he recommends when the accuracy of vision is disturbed by slight obscurations of the light-refracting media. The disturbance of sight in such cases Dr. Donders considers to be owing not so much to the reflection or absorption of a portion of the rays, as to the diffusion of the light passing through the obscurations. Hence exclusion of the light, which would otherwise reach them, increases the distinctness of the images. This is effected by looking through a small aperture.

In order not to limit the field of vision more than is necessary, the opening must be held as close as possible to the eye. It may, in general, have the form and nearly the size of the clearest part of the portion of the refracting surface corresponding to the pupil. It may, therefore, according to circumstances, be round, oval, or slit-like. Rarely will its diameter require to be less than one-twentieth of an inch; often it may amount to as much as one-tenth or one-eighth of an inch.

The apparatus with which Dr. D. tests the eye in order to determine the particular form and size of aperture which will be required, consists of a very short cylinder, having a funnel opening at the end next the eye, and provided at the other with a diaphragm, in which there are several apertures of different sizes, capable of being turned round, until the proper sized aperture is found; or, in which there is a slit, capable of being widened or narrowed at pleasure.

Diplopia with two eyes.—When complaint is made that objects are seen double (*diplopia*), it is necessary to ascertain whether the two images are seen only when both eyes are open. In this case the double vision depends on misdirection of the two eyes. Misdirection of the two eyes is objectively evident if owing to want of harmony in the action of any of the recti muscles, but is not so when owing to abnormal action of the oblique muscles. In this case the misdirection consists in loss of parallelism of the vertical and horizontal diameters of the eyeballs.

Polyopia with a single eye.—To a single eye objects may appear not double merely, but manifold, as if several were overlapping each other. This defect is noticed most when the adjusting power of the eye comes to fail, and the object is seen out of focus. That the case is of this nature will be shown if the object is seen single with the help of a concave or convex glass, according to its distance, and according as the patient is near or farsighted—that is, supposing the patient's eye be free from astigmatism.

Muscæ volitantes.—An appearance of motes or flies floating in the field of vision (*muscæ volitantes*) is owing to the shadows of minute objects on or in the eyes, usually in the vitreous body close in front of the retina, and is to be distinguished from the appearance of flashes and scintillations of light (*photopsy*), which is owing to irritation of some part of the optic nervous apparatus.

That muscæ volitantes are owing to the shadows of minute objects naturally existing in the eyes, is proved by the fact that any one may see them by looking through a small aperture at the clear sky. Their troublesome appearance is often owing to over-sensitiveness of the retina from disordered liver and stomach.

We have seen, however, that in morbid states of the vitreous humour, membraneous and filamentous shreds are seen with the ophthalmoscope floating in the vitreous humour. The shadows of such objects give rise to an appearance of muscæ volitantes in an exaggerated degree.

Daltonism, or defective perception of colour.—Cases occur in which persons are unable, in different degrees, to distinguish certain colours, their sight in other respects being unimpaired. Mr. Dalton, the late celebrated chemical philosopher, who was so affected, wrote on the subject; hence the name, *Daltonism.*

Amaurotic defects of sight.—When it has been ascertained by objective exploration of the eyes that dimness of sight does not depend on opacity of the cornea or lens, nor, by the tests above described, on defective adjustment, then there is reason to fear an amaurotic affection, depending on disease of the retina, optic nerve, or brain.

Amaurotic defect of sight presents itself in the various degrees and forms of *hemiopy*, *nightblindness*, *amblyopy*, confirmed *amaurosis*, &c. Whether the cause of amaurosis have its seat in the eyeball or within the cranium then becomes the question. Morbid changes in the retina, it has been above seen, may be observed by means of the ophthalmoscope. If none are thereby discoverable, the disease is probably intra-cranial, in which case there may be other symptoms of affection of the brain.

Fixed muscæ.—Fixed muscæ vary in number, size, and form. At first semi-transparent, they afterwards become black, or at least dark. They appear in reading like blotches on the paper.

Fixed muscæ are owing to insensible spots of the retina. The centre of the retina is sometimes the part affected, and the appearance seen is that of a dark spot in the middle of the field of vision. Thus the flame of a candle is, perhaps, invisible, whilst the light halo around is seen.

Exploration of the state of the field of vision.—Bearing in mind that it is the centre of the field only that normally can be seen quite distinctly, the patient is to be directed to fix the eye to be examined (the other being kept shut) on an object, such as a cross chalked on the centre of a black board at the distance of about a foot. We then move the piece of chalk over the board in different directions from the periphery towards the central object looked at by the patient, and request him to indicate the points where he continues to see the chalk distinctly, where he sees it indistinctly, and where he ceases to distinguish it at all. By noting down those where the object becomes indistinct or invisible, we may trace the limits of the visual field.

If it be desired to give greater precision to this exploration of the field of view, the board is to be divided into a certain number of equal-sized square compartments.

It is necessary to repeat the experiment several times, in order to correct the results of one experiment by those of another, varying the direction from the visual axis and the distance of the objects.

When we thus detect well-marked alterations in the distinctness of the sight, we acquire the important knowledge of the state of the degree of sensibility or insensibility of the retina in the different regions of its surface. Of course it is to be remembered, that if a dark place in the field appears to the right, it is the left side of the retina which is affected, and *vice versâ.*

Phosphènes.—The sensation of light may be called forth by impressions on our eyes made by other external agents besides that which is specially called light. Thus everyone knows that if we press on the eyeball as far back as possible, in the dark, we see a luminous spectrum before the eye, but on the side opposite to the spot where the pressure is applied—the side where the object whence the rays of light proceeded would have been, had the impression at the same part of the retina been made by light. From this mechanical impression on the retina no other sensation but that of light results; and if it were possible to apply more defined pressure on the retina, we should no doubt see a correspondingly more defined spectrum, as we indeed sometimes do, of the bloodvessels of the retina, when in consequence of undue congestion of blood in them, they cause pressure on that expansion of the optic nerve.

This production of a spectrum of light by pressure on the eye-ball, has been recommended under the above name of phosphènes,* by Dr. Serres d'Uzes, as a means of testing the degree of sensibility of the retina in cases of cataract, closed pupil, and the like, in which it is desirable to be assured of the integrity of the retina before operating. In the cases mentioned, in which the blindness is owing merely to the non-access of light to the retina, and not to any impairment of the sensibility of that nervous expansion, pressure on the eyeball excites spectra of unimpaired distinctness; whereas, if the retina be at the same time diseased, as in amaurosis, glaucoma, and the like, the spectra are either faint, or not produced at all, indicating that the visual sensibility is impaired or lost.

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* *φῶς*, light; and *φαίνω*, I make appear.

As a means towards the methodical employment of the test, M. Serres distinguishes four *phosphènes*, which he denominates from the points of the eyeball where the pressure producing them is exerted. The *frontal* phosphène is produced by pressure on the upper part of the eyeball, and appears towards the cheek. The *jugal* phosphène is produced by pressure on the lower part of the eyeball, and appears towards the middle of the orbital arch. The *temporal* phosphène is produced by pressure on the temporal side of the eyeball, and appears towards the root of the nose. The *nasal* phosphène is produced by pressure on the nasal side of the eyeball, and appears towards the temple.

Intermediate phosphènes are produced by pressure on intermediate parts of the eyeball.

The pressure is applied through the closed eyelids, by means of the point of the little finger or the round end of a pencil.

The different phosphènes above named have not all the same degree of luminous intensity. In respect to this intensity they may be classed as follows:—the frontal phosphène is the most brilliant,—after it the temporal,—then the nasal,—lastly the jugal, which is the most obscure.

The practical deductions drawn by M. Serres from this mode of exploration are as follows:—

When all the phosphènes are easily produced, it is to be concluded that the retina has preserved all its sensibility. If all the phosphènes are wanting, the retina is quite insensible and the sight extinct, unless it be in a restricted field in the central part of the retina, to which the exploration by pressure cannot be made to reach. When the phosphènes are indistinct, or altered, the sensibility of the retina is imperfect. When one phosphène is wanting, it may be concluded that the retina is diseased at the point corresponding to the place where the pressure is exerted. When the phosphènes persist, and vision nevertheless is defective, it may be concluded that it is the papilla and the central portion of the retina which are the seat of the morbid alteration, unless there be opacity of the media of the eye, or some defect in the state of its adjustment sufficient to account for the blindness.

Photopsy.—As along with loss of sensibility of the skin to external impressions there may be neuralgic pains, so along with amaurotic blindness there may be photopsy. This fact shows that the observation of phosphènes as a means of testing the visual sensibility of the retina is not to be much depended on. But even if it were trustworthy, we can judge much better of the visual sensibility of the retina by the direct action of light through the coats of the eye, and by objective observation, in cases of cataract and closed pupil.

Spectra from the retention of impressions on the retina, and complementary colours.—In certain morbid states of the retina, even although vision be much impaired, the sensation remains after the impression a much longer time than natural; hence arise illusions of vision from the spectrum and complementary colours. In such a case, if the person, after his eye has rested on some small and near object—the tassel of a blind, for example—should accidentally look towards the sky, he will there see projected an image of it magnified and of a reverse tint or colour; but, not aware of the cause, he may be surprised by what appears to him a gigantic human figure in the air.

Phantasms.—Besides the subjective sensations of photopsy, &c., and which are owing to the communication to the brain of a change of state of the nerves of the senses concerned, induced by a cause operating within them, there is another class of subjective sensations, which have their origin in the reaction of the mind on the senses. To this class belong *phantasms.*

Phantasms of touch are exemplified in the pains of hypochondriacs. In regard to phantasms of hearing, people sometimes imagine that they hear not only sounds, but spoken words. The phantasms of vision are those, however, which have attracted most interest. Appearances as if of various objects—landscapes and figures, for example, even walking figures — present themselves before the eyes. Nay, phantasms of both hearing and vision may occur together—the human figures seen being, at the same time, heard talking. In the celebrated case of Nicolai, the Berlin bookseller, the phantasms were at first *seen only*, but after a time they were *heard also.*

Phantasms occurring in persons of strong mind and cultivated intellect are recognised as such. This was the case with Nicolai, referred to.

In the case of persons of uncultivated intellect, phantasms have, no doubt, been the origin of many ghost stories. Whilst in persons of weak intellect, not otherwise actually insane, they may lead to hallucinations prompting to insane actions.

SECTION II.—THE VARIOUS FORMS OF LOCAL REMEDIES, AND THEIR MODE OF APPLICATION TO THE EYES OR NEIGHBOURHOOD.

1st. *Cold applications.*

Cold lotions.—Cold spring water is the best cold lotion. It is applied by means of compresses of old linen or lint, which should be broad enough to extend over the neighbouring parts as well as over the eye, but not so heavy as to press unpleasantly. When once commenced, the application of the cold lotion requires to be assiduously kept up as long as is necessary, one compress as soon as it becomes warm being replaced by another just taken out of the water. The application of cold is also sometimes made by means of a small bladder loosely filled with ice laid over the eyes.

Cold douche bath.—This consists in a fine stream of cold spring water allowed to play on the closed eye and neighbouring parts. The application may be continued for about five or ten minutes at a time. There are particular douche apparatuses to be had. An equally efficacious, and certainly a simpler douche, may be applied by leaning the face over a basin of cold water and, with the hand, throwing the water up against the closed eyelids.

Dry cold.—In the weak and rheumy eyes of old persons, and in a similar state remaining after an attack of ophthalmia, it is often agreeable, and indeed productive of great relief, occasionally to draw some cold body across the eyelids. For this purpose a long slender bottle, with a smooth round bottom, filled with ice, has been recommended.

2nd. *Warm applications.*

Warm cataplasms and fomentations.—As applications to the eye, fomentations are much more convenient and elegant than poultices. Warm water simply may be used for the purpose, or chamomile decoction, poppy decoction, and the like. The application is made by means of compresses over which oiled silk is laid. Warm cataplasms and fomentations should never be allowed to become cold on the eyes. When the eye is to be bathed simply with water, the application requires only to be made occasionally, and that merely for a period of a few minutes at a time. After that, as well as after the removal of warm cataplasms or compresses, the eyes are to be gently dried with a soft linen cloth, and care taken that they be not exposed to a draught of air.

Watery vapours.—In order to receive watery vapours on the eyes, the patient holds his face over a vessel containing hot water; a cloth being thrown over all. When it is wished to have the steam play more directly on the eye, a funnel is inverted over a small basin, and the tube directed towards the eye at a proper distance. After the application, the face and eyelids are to be well dried, and exposure to any draught of air carefully avoided.

3rd. *Medicated vapours.*

Medicated watery vapours.—In certain cases, the hot water is mixed with some aromatic or narcotic substance, such as tincture of opium, tincture of camphor, compound tincture of camphor, tincture of hyoscyamus, or of belladonna, in the proportion of a teaspoonful or two to the cupful of hot water about to be used for steaming.

Dry warmth and vapours of aromatic or narcotic substances.—Bags of aromatic or narcotic herbs hung over the eyes used to be employed partly to keep up dry warmth, and partly for the sake of the exhalations they give out. The bags are made of coarse lawn or muslin, washed and rubbed soft. Being lightly filled, the bag is sewed close, and then quilted at different places, so as to keep the materials equally spread out, and to prevent them from sinking down. The bags ought to be made as light as possible, not more than of the thickness of a finger, and about the size of a playing-card. They are fixed to a band passed round the forehead, so as to hang free; they ought not to be bound over the eye. The bags are warmed before being applied. The materials for filling the bags with, are aromatic species (chamomile flowers, sage, rosemary, thyme, &c.), mixed or not with shavings of camphor. The species are reduced to a coarse powder, from which all dust is to be separated by a sieve. To fill a bag of the size above indicated, one and a half to three drachms of herbs, flowers, &c., will be required. When *camphor* is the only active substance employed, cotton wool, impregnated with it, is to be used for filling the bag. The impregnation is readily effected by soaking the wool in strong spirit of camphor, and then allowing it to dry quickly: when dry, the wool is teased out.

Herb bags are not now much used.

Stimulating vapours.—The vapour of the weaker volatile fluids is applied by spreading the fluid out on a warm surface, and allowing it to evaporate near the eyes. Thus, having poured a few drops of the fluid into one hand, and spread it out on the palms of both, by rubbing them quickly together, the hands are to be held one before each eye more or less close according to the strength of the material and degree of action desired.

The vapour of hydrocyanic acid is applied to the eye by means of a small bottle, the mouth of which expands into a cup like an eye-glass. A few drops of the diluted acid being poured into the bottle, the cup is to be applied to the eye, which will thus receive the vapour as it rises.

4th. *Anodyne friction.*

Friction over the eyebrows or on the temples with some anodyne is often of use in mitigating the supra-orbital or temporal pain, which attends many internal ophthalmiæ. The belladonna or atropia ointment of the Pharmacopœia, alone, or combined with an equal quantity of the weaker mercurial ointment, often proves an efficacious anodyne. The following tincture of tobacco is sometimes also useful:—

℞—Tabaci fol. concis. ℥j ß.
Camphoræ pulv. ʒj.
Alcohol. fort.
Aq. destillat. āā ℥jv.
Digere per dies octo et cola.
Sig. ʒß.—ʒij. to be used at a time.

5th. *Collyria, &c.*

The word Collyrium, as at present understood, means an eye-water, but formerly it was applied to any medecine for the eyes, whatever its form. Recurring partially to the original and wider acceptation, it is purposed under this head to treat not only of eye-waters, but also eye-salves and eye-powders. The skin of the eyelids, and the conjunctival surface, are the parts of the eye which, under ordinary circumstances, are most open to the contact of remedies; the derivative lacrymal passages, though also directly, are less easily accessible. Of the other parts of the eye, the proper substance of the cornea, when laid bare by ulceration, and the iris when it is prolapsed in consequence of a wound or penetrating ulcer of the cornea, are those which may become the subject of the direct action of medicinal substances. The lacrymal gland and Meibomian follicles may be influenced by the action of collyria on their excretory orifices. Of the internal tunics, the iris is acted on by the external application of belladonna, &c. The others are also affected by applications to the conjunctiva, though in general, when these are irritating, rather injuriously than beneficially.

Of late years glycerine has been much employed as an excipient in the preparation of collyria. In its pure state glycerine mixes perfectly with all medicaments employed for application to the eyes, dissolving some and holding others in suspension. The nitrate of silver is the only exception, as it becomes decomposed.

Glycerine applied to the edges of the eyelids by means of the fingers keeps them from becoming glued together by the discharge, which it dissolves, and thus prevents the formation of crusts. If crusts already exist, glycerine rapidly softens them, so that they admit of being readily removed.

Glycerine heated with starch forms a "plasma," which constitutes a good basis for eye ointments.

Eye-waters and drops are solutions of astringent, stimulant, or narcotic substances, or of all combined. Their state of concentration regulates the mode of application, hence the division into eye-waters properly so called, and drops for the eyes.

Eye-waters properly so called, are the weaker solutions, and are used to bathe the eye with occasionally in the course of the day. The fluid is to be put into a cup in sufficient quantity and made tepid. The patient, holding his head over the vessel, is to lave his eye with the water by means of a piece of lint or soft linen rag; and after this has been done for a few minutes, some of the fluid may be dropped fairly into the eye by an assistant squeezing the soaked rag over it, while the patient lies on his back, and holds his eyelids apart. After this, the eye may be laved again for a minute or so, and then carefully dried with a soft linen cloth. An eye-glass is not to be recommended.

A principal object in the process above described is to remove any discharge from the eye. In the blennorrhœal ophthalmiæ, when the eyelids are enormously swollen and cannot be opened, it is the custom to inject the eye-water between the eyelids, after they have been cleansed as much as possible by means of the bathing simply. In using the syringe, however, care must be taken not to injure the patient's eye by pressure or the like, and on the other hand, the operator should guard his own eyes from receiving any spirt of matter. But, as will be pointed out under the proper head, the eyes may be quite well cleansed, and applications made to the conjunctiva without the use of a syringe.

In order to act on the inner surface of the lacrymal passages, the simplest way of applying the eye-water is to drop it into the inner corner of the eye, and leave it there a short time so as to be taken up by the puncta. It is sometimes also injected directly through the puncta and canalicules by means of Anel's syringe. Injections are occasionally thrown into the lacrymal passages from the opening of the nasal duct into the nose; but when an external opening into the lacrymal sac exists, whether it has been made by operation or the bursting of an abscess, we have the readiest access to the mucous surface of the lacrymal passages.

Examples of eye-waters :—

℞—Belladonnæ extracti, ʒß.
Aquæ puræ, ℥viij.
Solve et per linteum cola. Or,

℞—Atropiæ sulphatis, gr. j.
Aquæ, ℥viij.
Solve.
Sig.—Sedative eye-water, to be used tepid.

℞—Aluminis, gr. xvj.
Aquæ rosæ, ℥viij.
Solve. Ft. aqua ophthalmica.

℞—Sulphatis zinci, gr. xvj.
Aquæ rosæ, ℥viij.
Acidi sulph. dilut. gtt. xvj.
F. Solutio pro aqua ophthalmica.

℞—Hydrargyri corrosivi sublimati, gr. j.
Ammoniæ hydrochlorat. gr. ij.
Aquæ destillat.
Aq. ros. singulorum, ℥iv.
Solve, &c.

℞—Lapidis divini,* gr. xvj.
Aquæ destillat. ℥ij.
Solve et cola.
Colaturæ adde aquæ rosarum, ℥vj.
Misce, &c.
Sig.—Eye-water.

N.B. To any of the four last solutions a drachm of vinum opii may be added. The following are the directions for use:—To half a tea-cup-ful, add as much hot water as will make the whole lukewarm. With the quantity thus prepared, the eyes are to be bathed as directed, p. 79.

℞—Aceti aromatici, ♏v.
Spiritus ætheris nitrici, ʒj.
Aquæ rosæ.
Aquæ puræ, āā ℥iij.
Misce.
Sig.—Cooling lotion, to be used for bathing the forehead, temples, and cheek.

Drops.—These may be applied by means of a quill or glass tube, but a large camel's hair pencil will be found the most convenient instrument. It is to be remembered, however, that to avoid accidents, each patient should have a separate pencil, which ought to be well washed every time it is used. The lower eyelid being slightly everted, its inner surface is to be touched with the loaded pencil, when the fluid will be immediately drawn off and diffused over the lower part of the conjunctiva. Pains must also be taken to allow the drop to make its way underneath the upper eyelid by drawing this from contact with the eyeball, and then moving it slightly up and down. It is frequently necessary to evert the upper eyelid, and to pencil its conjunctival surface directly.

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* ℞—Æruginis,
Nitratis potassæ,
Aluminis āā partes xvj.
Terantur simul et liquefiant in vase vitreo in balneo arenæ. Liquefactis adde camphoræ tritæ partem j.: Misce.
Massa refrigerata servetur sub nomine Lapidis Divini.

Applied in the ordinary way, salves, eye-waters, and drops, scarcely ever come into contact with the conjunctiva of the upper eyelid and upper part of the eyeball * in any degree of concentration, and too often what gets there acts rather as an irritant than otherwise. I consider it of great importance to insure the access of an application to the upper parts of the conjunctiva, because I have seen cases treated unsuccessfully, or rather irritated for a long time by applications, which, when properly introduced, did not fail of a speedy beneficial operation.

In order to apply drops to the eye of a child with the least possible trouble, the surgeon is to seat himself on a chair, with a towel folded longways, laid across his knees. On another chair, on the surgeon's left hand, and a little in front of him, the nurse with the child sits in such a way, that when she lays the child across her lap, its head may be received on the towel, and between the knees of the surgeon, and thus held steadily. The nurse confining the hands and arms of the child, the surgeon easily draws down the lower eyelid, and drops in the fluid; he then draws the upper eyelid up a little, and also from contact with the eyeball, in order to allow the drop to get underneath. The eyelids are then alternately to be drawn from each other and made to approach, so as to favour the spreading of the fluid over the whole conjunctival surface.

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* In illustration of this, it may be mentioned, that in most or all the cases in which, from the abuse of the nitrate of silver drops, the conjunctiva has become dyed of a dark olive or actually black, it is the lower part of this membrane which is so affected. In such cases, besides being discoloured, the conjunctiva is often found much shrunk and in a state of incurable chronic inflammation. In extreme opposition to the notion that, drop in the nitrate of silver solution long enough and the ophthalmia will be cured, which leads to such deplorable results, is the disposition to decry the employment of the remedy altogether. The nitrate of silver solution is, however, a valuable application, if properly used.

Examples of eye drops.

Vinum opii, pure, or diluted with one or two waters, is often used for dropping into the eye.

℞—Nitratis argenti, gr. iv.—x.
Aquæ destillatæ, ℥j.
Solve.

℞—Hydrargyri corrosivi sublimati, gr. ss.
Aquæ destillatæ, ʒvij.
Solve et cola. Colaturæ adde vini opii, ʒj.
Misce.

℞—Lapidis divini, gr. v.—x.
Aquæ destillatæ, ʒvij.
Solve et cola. Colaturæ adde vini opii, ʒj.
Misce.

℞—Extract. belladonnæ, gr. xx.—xxx.
Aquæ destillatæ, ℥j.
Solve et per linteum cola.

℞—Atropiæ sulphat. gr. ij.—iv.
Aquæ destillatæ, ℥j.
F. solutio.

Calabar bean drops.—The Calabar bean is applied to the eye in the form of a fluid extract, one drop of which is equal to one grain of the bean.

Gelatine as a vehicle for the application of Atropia and Calabar bean.—Mr. Streatfeild has recommended, as more convenient and portable than the solution, gelatine in thin sheets impregnated with the sulphate of atropia in such a proportion, that a piece one-fifth of an inch square contains as much as a drop of the solution. A piece of the atropia-gelatine, of the size mentioned, is placed in the oculo-palpebral sinus of the lower lid, and left there to dissolve. The atropia being thus set free, produces its effect on the pupil. Mr. Streatfeild had previously used tissue paper impregnated with atropia (Oph. Hosp. Reports, Jan., 1862), but as the piece of paper required to be removed after the atropia was dissolved out, which could often be done only by the surgeon himself, the substitution of gelatine is an obvious improvement on the original invention. See Mr. S.'s paper in the Brit. and For. Med. Chr. Rev. for January 1, 1864.

In the case of the Calabar bean, the gelatine is impregnated with its extract in the same proportion.

Eye-salves.—Salves are applied to the borders of the eyelids, or to the whole conjunctival surface. In the former case only, should the patient or his attendants be intrusted with the application. In the latter case, more discrimination, as well as tact, being required, the surgeon should apply the salve himself.

Before applying a salve to the edges of the eyelids, all incrustations of matter about the roots of the eyelashes must be removed. This is done by first rubbing the part with glycerine, fresh butter, or lard; the incrusting matter is thus softened, and may readily be separated with the finger-nail or head of a pin. All loose eyelashes should at the same time be plucked out.

The anointing of the edges of the eyelids may be performed by means of a hair pencil, or simply with the point of the finger. The eyelid being held slightly everted, the salve is applied along its border to the mouths of the Meibomian follicles, then smeared outside the insertion of the eyelashes, and afterwards carefully rubbed in at their roots.

When a salve is to be applied to the whole surface of the conjunctiva, a piece the size of a split pea is to be taken up on the point of a probe, or on the point of the nail of the little finger, and insinuated under the upper eyelid, while this is drawn forward from contact with the eyeball. When the salve is fairly in the eye, the upper eyelid is to be gently drawn down, and rubbed over the eyeball with the finger for a minute or so, in order to diffuse the salve, now melted by the heat of the eye, between the eyelids and eyeball, and consequently all over the conjunctiva.

If the palpebral conjunctiva be the part on which the salve is principally to exert its action, the application may be limited to it, in which case the pain is less severe than in the former. Having everted the eyelids, the exposed conjunctival surface is to be rubbed with the salve either by means of a hair pencil or the point of the finger.

Salves are sometimes applied to the lacrymal passages, by smearing the styles, catgut-strings, &c., which are introduced into the nasal duct, whether from the nose or through an external opening into the lacrymal sac.

In regard to the application of a strong salve to the eye, it is necessary here to give a caution, viz., not to insert it in a lump within the lower eyelid and leave it there. I have seen the conjunctiva of the inferior palpebral sinus in a sloughy state from a lump of nitrate of silver ointment having been put in, and no care taken to diffuse it by rubbing the eyelid over the eyeball. In the case of ointment inserted under the upper eyelid, the natural motions of the part will make up in some degree for the neglect of the surgeon.

Examples of eye-salves.

℞—Oxidi hydrarg. rubri bene lævigat. gr. iii.—vi.—xv.
Axungiæ præparat. ʒij.
Misce accuratissime : ft. unguentum ophthalmicum.

The two weaker forms are used for anointing the edges of the eyelids, and may be intrusted to the patient. The strongest form should be applied only by the surgeon himself. Applied to the whole conjunctival surface it is found a very efficient remedy in various inflammations of the conjunctiva, and ulcers, specks, &c., of the cornea. It is less severe in its operation than the nitrate of silver ointment.

The citrine ointment, or ointment of the nitrate of mercury, of the pharmacopœias, diluted with three or more parts of lard or oil, is a useful application to the edges of the eyelids.

The common sulphur ointment of the pharmacopœias I find of great use in granular conjunctiva. It is applied by insinuating a piece, the size of a split pea, under the upper eyelid, as above explained.

℞—Argenti nitrat. gr. x.
Aquæ destillat. q. s. ad solvend. nitrat.
Unguent. cetacei, ℥j.

Prius solvatur nitras; dein misceatur accuratissime solutio cum unguento.

This ointment has been used with much success not only in chronic, but also in cutting short acute inflammations of the conjunctiva; but the pain it causes is very severe.

The following is what is known by the name of Janin's ointment for the eyes:—

℞—Hydrargyri ammoniati *vel* Præcipitati alb. gr. xv.
Tutiæ præparat.
Boli armen. ppt. āā ʒss.
Adipis suilli, ʒi.—ʒij.
M. exactissime : ft. ungt. ophthalmicum.

It is of great consequence that eye-salves should contain no gritty particles; the powders entering into their composition, therefore, should first be reduced by trituration to as impalpable a state as possible, and then carefully levigated previously to being mixed with the excipient. Substances soluble in a small quantity of fluid, such as the nitrate of silver and sulphates of zinc and copper, may be dissolved. When camphor enters as an ingredient into an eye-salve it should first be dissolved in a fixed oil. The excipient best adapted for eye-salves is cocoa butter mixed with olive oil to reduce it to a proper consistence, prepared lard, simple cerate, spermaceti ointment, or the plasma formed by glycerine and starch heated together.

Eye-powders or Dry Collyria.—The application of irritating powders to the eye is much less frequent now than formerly.

Examples of eye-powders :—

Calomel is the substance most used as an eye-powder. It is dusted into the eye by means of a dry camel-hair pencil. It is much to be recommended in the puro-mucous ophthalmiæ, and, indeed, in any of the conjunctival inflammations in which the nitrate of silver drops are used.

The surgeon should always make the application himself.

Refined sugar or sugar-candy reduced to a very subtle powder is used as an excipient and diluent of other substances, thus :—

℞—Oxidi hydrarg. rubri, gr. x.
Sacchari purif. ʒj.
Misce et tere, &c.

Of late the neutral acetate or sugar of lead in fine powder has been much extolled in Belgium, as a remedy in *granular conjunctiva*. The eyelids being everted, and wiped with a bit of lint, this powder is laid on the affected surface by means of a camel-hair pencil or the point of the finger. After remaining a minute or so, it is to be washed off.*

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* From lead applications an opaque white deposit is liable to take place on abrasions or ulcers of the cornea or conjunctiva. This bad effect, different from the bad effect arising from the

6th. *Potential cautery.*

It is sometimes required to touch fungosities of the conjunctiva, ulcers of the cornea, prolapsed iris, partial staphyloma, &c., with caustic. The caustic usually employed is the nitrate of silver. In performing the operation, an assistant secures one eyelid, the surgeon the other, and that in a way according to the part which is to be cauterised. The surgeon then proceeds to make the application of the caustic, carefully confining it to the particular spot. This being done, the part is to be dried by touching it with a bit of lint; some sweet oil or glycerine is then to be pencilled on it before the eyelids are allowed to close.

In cases of purulent ophthalmia it is often advantageous to pencil the conjunctiva lightly and rapidly with the solid nitrate of silver.

Blue-stone has been very extensively abused in the treatment of granular conjunctiva. In the hope of eventually destroying the so-called "granulations," it has been perseveringly rubbed on the inner surface of the eyelids. The result of this practice too often has been the destruction of the palpebral conjunctiva, as well as the "granulations;" the tarsal cartilage being left covered with nothing but a callous epithelium. In such cases, of which I have seen many, this result of the abuse of blue-stone has been generally found greatest on that part of the palpebral conjunctival surface which projects most when the upper eyelid is everted, betraying a mal-application, as well as an abuse of the escharotic.

Of course, it is to be understood, that the sulphate of copper is as good as any other remedy of the kind when properly employed, and not worse than the nitrate of silver or acetate of lead when abused.

7th. *Counter-irritation.*

In diseases of the eye, counter-irritation is usually made on the nape of the neck, behind the ears, or on the crown of the head, by means of repeated blisters, tartar-

abuse of nitrate of silver above noticed, may result from a single application. Hence, when abrasions or ulcers of the cornea or conjunctiva exist, acetate of lead collyria are especially contra-indicated.

emetic plaister, or rubefacient liniments. Counter-irritation is sometimes applied nearer the affected organ, as on the temples, above the eyebrow, or even directly on the outside of the eyelids. When the counter-irritation is required to be long continued, it is made by means of warm plaisters between the shoulders, a seton in the nape of the neck, or issue in the arm.

The most convenient counter-irritant, perhaps, especially for application behind the ears, on the temple, above the eyebrows, or even over the eyelids, is the following spirituous solution of iodine painted on the skin :—℞ Iodi, ʒi—Potassii iodidi, ʒss.—Spiritus rectificati, ℥ss.; Solve.

Cauterization with nitrate of silver may be also employed. Even the application of blisters to the eyelids has been recommended. The cantharidal collodion has been found a convenient vesicant, especially for children.

Section III.—Performance of Certain Operations Applicable in Different Affections of the Eyes.

1st. *Abstraction of blood.*

Cupping.—When blood is to be abstracted by cupping in diseases of the eyes, it is usually on the nape of the neck, or on the temples, that the operation is performed. Cupping on the latter region is not much to be recommended.

Application of leeches to the eyes.—The region corresponding to the margin of the orbit all round, the side of the root of the nose, and the temples, close to the outer angle, are the places where leeches are most advantageously applied in inflammation of the eyes. A leech or two are sometimes applied within the nostrils, and occasionally to the conjunctiva of the sinuses, though the latter is a place of application not much to be recommended—first, because the resulting wounds are elevated, and cause irritation like foreign bodies; and secondly, because scarification is preferable.

Half a dozen or a dozen is the average number applied around one eye in a grown-up person. In children, when it is necessary to abstract blood, two or three leeches to the region of the inner corner are sufficient. In very young infants, it is to be remembered that the after-bleeding from even one leech may prove fatal, if allowed to continue. Scarification is therefore to be preferred, especially as the affection of the eyes in infants requiring bleeding is the ophthalmia neonatorum, in which a few scratches on the gorged conjunctiva of the everted lids are sufficient to produce a considerable and more beneficial discharge of blood.

When the after-bleeding (which, it is to be remarked, usually takes place in any quantity from certain of the bites only, and generally more freely on a first than on a subsequent application), has been kept up sufficiently long by means of warm fomentations, these are to be laid aside, and the skin carefully dried, when the bleeding will in general cease of itself; if not, pressure is to be made on the bites with the point of the finger for a short time, or the bites touched with much-diluted nitric acid (gtt. j.—ʒij.), or, what is more effectual, the solution of the perchloride of iron.

Discolouration of the eyelids from ecchymosis generally results from the application of leeches, for which the patient should be prepared. From idiosyncrasy, erythema or erysipelas—with very considerable œdema, perhaps—is sometimes the result of the application of leeches to the face. In ordering leeches, therefore, to that region, inquiry should be made if leeches were ever applied before, and if any such tendency to erythema manifested itself. Though alarming to the patient, the erythema and œdema in general soon subside. A saturnine lotion may be used as an application in such a case. Sometimes, especially under the circumstances just mentioned, suppuration of the wounds takes place, and knotty cicatrices are left.

Scarification of the conjunctiva of the eyelids and sinuses.—The simplest instrument for this purpose is a common lancet, rounded at the point. Scarification is called for when the palpebral conjunctiva, and especially the conjunctiva of the sinuses, is gorged with blood and sarcomatous-looking. In such a state superficial scratches are quite sufficient to give issue to a considerable quantity of blood. Deep scarifications ought not to be made. When free bleeding does not take place from superficial scratches, the case is not one for scarification at all. As the blood flows, it is to be taken up with a bit of dry lint held to the edge of the eyelid, but not allowed to touch the scarified part, as this is apt to cause the bleeding to stop. Bathing with warm water also stops the bleeding. The flow of blood is best promoted by every now and then allowing the eyelid to become less everted, and then again fully renewing the eversion. When, however, the blood begins to coagulate on the scratches, and its further flow ceases, the flakes of coagulated blood may be removed with the lint, and a few more scratches made with the lancet. When the conjunctiva of both eyelids is to be scarified it is best to begin with the upper.

Scarification of the conjunctiva of the upper eyelid.—The upper eyelid is not so easily everted as the lower; but in those cases in which scarification is most required, the eversion is generally readily enough effected, on account of the swollen state of the conjunctiva. The upper eyelid being everted, as already described (p. 10), it is to be kept so by pressing the tarsal edge against the upper margin of the orbit with a bit of lint whilst the scarifications are made, and as long as the blood flows. When the conjunctiva of the palpebral sinus is much congested and sarcomatous, as in ophthalmia neonatorum, it protrudes greatly, and should be freely scarified. In some cases of chronic inflammation, the conjunctiva of the upper eyelid is red and spongy-looking towards the angles, but not much affected in the middle. In these cases the scarification is to be confined to a slight scratch or two on the red and spongy places.

Scarification of the conjunctiva of the lower eyelid.—In order to this, while the upper eyelid is held somewhat raised by an assistant, the operator everts the lower eyelid, by applying the points of the fore and middle fingers of his left hand on the middle of the eyelid, and in such a way that the extreme points correspond to the insertion of the eyelashes. The skin of the eyelid and neighbouring part of the cheek is now to be drawn down a little; and when this is effected, the extreme points of the fingers are to be directed backwards, gently pushing them a little between the lower margin of the orbit and the eyeball. By this means the eyelid is fully everted, and the conjunctiva of the sinus exposed and rendered prominent, when the scarifications are to be made.

In granular conjunctiva, a mode of scarification which I have employed with advantage, consists in making a small crucial incision through each granulation, or when they are small and closely compacted, by making a number of cross hatches.

It has been objected to scarification, that the traumatic irritation which is occasioned does more harm than all the good effected by the loss of blood. But this is certainly not a correct view of the matter. In the proper cases, mere superficial scratches are sufficient to give issue to a considerable quantity of blood; thereby relieving the congestion of the conjunctiva, and thus preparing it to be more beneficially acted on by the applications made to it immediately after.

Division of enlarged vessels in the sclerotic conjunctiva.—This may be readily effected by means of a small sickle-shaped needle introduced through the conjunctiva under the vessel, and made to cut itself out, by which manœuvre the vessel is divided. But it is usually found better to excise a portion of the vessel in order to obviate the re-union of the divided ends, and the refilling of the vessel, which readily take place. To effect this, the eyelids require to be held apart by an assistant, as both hands of the surgeon are necessarily engaged, the one in taking up with a hooked forceps a fold of the conjunctiva, containing the portion of vessel to be excised,—the other in snipping it and a piece of the vessel away with a pair of curved scissors. The scissors should be held with the convexity towards the eye, and ready for use, before the fold is taken hold of with the forceps. Though the fold of conjunctiva is snipped away, the vessel may not be cut, but merely exposed; in this case the exposed part of the vessel is to be seized directly with the forceps and cut away. Division of enlarged vessels is, however, a practice not much to be recommended.

Incision of chemosed conjunctiva.—In chemosis, the elevated fold of conjunctiva all round the cornea requires to be incised, partly for the sake of the bleeding thereby occasioned, and partly to relieve the tension of the conjunctiva, and the pressure it exerts on the cornea. The best and safest plan is to make the incision with a pair of straight blunt pointed scissors, in a direction radiating from the cornea. The eyelids being held apart by an assistant, the surgeon with a pair of hooked forceps takes hold of the over-lapping fold of conjunctiva and cuts it across with the scissors. A radiating incision results. Three or four such incisions may be made at equal distances round the cornea.

The excision, by means of a hooked forceps and curved scissors, of small folds of the chemosed conjunctiva, here and there; or the excision of the whole of the chemosed conjunctiva with the sub-conjunctival cellular tissue, all round the cornea (an operation to which the name of *syndectomy* * has been given) is a proceeding of doubtful advantage.

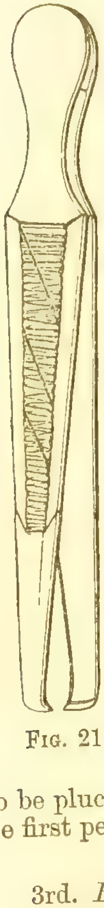

Fig. 21.

2nd. *Evulsion of Eyelashes.*

The instrument best adapted for the performance of this simple but nice operation, is a forceps with broad points, like tweezers, Fig. 21; but a common good anatomical forceps will do. The eyelid being slightly everted and drawn from the eyeball with his left hand (p. 8), the surgeon, with the forceps in his right hand, proceeds to pluck out one hair after the other singly; and the mode of doing so is to take hold of it with the forceps as near its root as possible, and to pull it out steadily in the direction of its insertion—not too quickly nor with a jerk, as by doing so the eyelash is more apt to be broken short. If the eyelash should break short, its stump must be carefully looked for, seized with the forceps and plucked out, for if left it would irritate more even than the eye-lash did when entire. If eyelashes are to be plucked out from both eyelids, the operation should be first performed on the upper.

3rd. *Foreign bodies in the oculo-palpebral space of the conjunctiva, and their removal.*

When a foreign body has got into the oculo-palpebral space of the conjunctiva, it is, in common language, said to have got *into the eye.*

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* The practice of excising a strip of conjunctiva all round the cornea, first advised by Scarpa for nebula, then by Sanson and Julliard, along with cauterisation, in blennorrhagic ophthalmia, has again been recently brought forward, under this name, as a method of treating granular conjunctiva and pannus, but is again being abandoned.

Chemical or mechanical irritation of the conjunctiva is followed by a spasmodic closure of the eyelids and the discharge of a flood of tears. If the irritation has been produced by a substance in the state of vapour, the conjunctiva is in this way protected from its further action, and the smarting soon subsides. Strong acid vapours, however,—of nitrous or hydrochloric acid for example,—may at once produce serious injury by decomposing the epithelium of the conjunctiva and cornea.

Consistent substances of a kind not calculated to adhere to the conjunctiva, are either immediately washed out of the eye by the tears, the discharge of which they have excited, or, in the case of small particles, they may be found after some time lying enveloped in mucus in the lacus lacrymalis, having been carried thither by the movements of the eyelids, and the stream of tears.

When a foreign solid particle lies between the firm part of the eyelid and the eyeball, it causes great irritation, and excites the orbicularis muscle to strong spasmodic action. This serves but to aggravate the distress, by fixing the particle, if it be of a nature to adhere to the conjunctiva.

In a case in which a foreign body has got into the eye, and from the seat and severity of the irritation it is supposed to be lodged between the firm part of the upper eyelid and the eyeball,—if on gently raising the upper eyelid, and carefully examining the surface of the cornea and white of the eye, the foreign particle be not detected there, the upper eyelid should be everted, and its conunctival surface examined as above described (p. 10), when most probably the offending particle will be discovered adhering to it. If the foreign particle is not at once detected, the possibility of its being transparent should be taken into consideration, and an examination of the whole exposed surface made with great care, by the touch as well as by the sight.

The foreign particle having been detected, it may readily be removed by the touch of a hair pencil, moistened and brought to a point, or of a toothpick, or the eyed end of a probe, or any other flat blunt pointed instrument.

Foreign bodies when within the lower eyelid do not ause so much irritation as when within the upper, and heir detection is more easy, the lower eyelid being more eadily everted than the upper (p. 9).

Foreign bodies which have entered the oculo-palpebral space sometimes get lodged in the palpebral sinuses of the conjunctiva, and may there be retained for a length of time, without much or any irritation, the conjunctiva of the sinuses being so loose, and the subjacent cellular and adipose tissue of the orbit so soft, that the body is not much pressed on by the opposing surfaces. The large size of the bodies which have been found lodged in the palpebral sinuses without having given rise to irritation, is astonishing.

When, therefore, notwithstanding the absence of much or any irritation, there is still reason to believe that a foreign body is in the oculo-palpebral space, and when by the mode of examination above-described it has not been detected, attention should be directed to the palpebral sinuses, and an exploration of them made as above described (pp. 9, 10).

Cases not unfrequently occur in which splinters of wood, pieces of straw, fragments of tobacco-pipe, &c., have penetrated through the conjunctiva of the sinuses into the orbit, and their presence, for want of careful exploration, overlooked.

A foreign body, especially when projected with force into the eye, may at once adhere to the ocular conjunctiva—generally the conjunctiva corneæ. It sometimes happens that the husks of small seeds, and other analogous bodies, such as the wing-case of certain insects, or, as I have seen in a fisherman, one of the valves of a minute bivalve shell, getting into the eye, adhere very closely to the sclerotic or corneal conjunctiva. Inflammation having set in, these foreign particles are liable to be mistaken for pustules or phlyctenulæ, resulting from the inflammation. This, therefore, should lead to a careful examination in any suspected case, when the nature of the body on the cornea cannot fail to be recognised. Removal is readily effected by any of the instruments above mentioned.

The ignited sparks detached from iron instruments in the course of various mechanical operations, called *fires*, and which so frequently strike and sink into the conjunctiva corneæ of the workman, appear as small dark brown points on the surface, with some dimness of the cornea around. They give rise to more or less pain, especially when the eyelids are closed together, with redness and lacrymation.

The foreign body is at first firmly fixed, but afterwards becomes loose. It is in general easily turned out of its nidus by means of a toothpick or small silver spatula. When removed it is found, on close examination, to be black oxide of iron fused into a minute globule or pellicle. The cornea at the point whence it was removed remains of a rusty colour, so that the appearance is as if the particle was still there.

If the removal from the eye of such foreign bodies as are above mentioned, is effected soon, the distress is in general at once relieved or greatly mitigated. Sometimes a sensation remains as if the foreign body were still in the eye; this is owing either to vascular injection or to abrasion of some part of the conjunctiva.

Caustic or hot substances, whether solid or fluid, getting into the eye, so quickly exert their action, that much, if not all, the injurious effects have already occurred before means can be taken for their removal.

While solid caustic substances are still in the eye, the best application to make in the first instance is sweet oil. After that, the surgeon may proceed to remove the foreign substance, and to effect this some pains will often be required, especially if it has been lime or mortar, for the particles of these substances are apt to adhere very closely to the conjunctiva. Exploration of the palpebral sinuses should not be neglected lest pieces may have lodged there. After the eye has been freed as completely as can be done from particles of lime or mortar, sugared water should be injected into the eye in order to carry away what remains of the caustic may exist.

When gunpowder has been exploded into the eye, besides the burn which results, the grains may fix in the conjunctiva and in the cornea—in which case, unless carefully picked out, they will leave indelible marks and opacities. The grains have even penetrated through the cornea and lodged in the lens, causing cataract.

Particles of such substances as potass, nitrate of silver, &c., getting into the eye, quickly become dissolved in the tears, and their injurious operation may spread like that of a caustic fluid, before they can be removed.

In this case, and in the case of caustic fluids, the application, in the first instance, should be some substance calculated to decompose them and render them inert, so as at least to arrest their further destructive action; thus, in the case of sulphuric acid, which has sometimes been thrown into the eyes of persons with the criminal intention of destroying them, a solution of carbonate of soda—gr. iv. aq. ℥j.—or magnesia suspended in water should be immediately used as a lotion and injection for the eyes.

Simply hot substances, such as melted tallow, pitch, or lead, quickly cool of themselves, and all that is required in the first instance is their removal. If pitch cannot be readily removed, sweet oil will promote its separation.

The injury occasioned by the intrusion of foreign bodies into the eye, and its treatment; as also the penetration of foreign bodies into and their lodgment within the eyeball, will be considered under the head of *Injuries of the Eye.*

CHAPTER II.

THE NATURE AND TREATMENT OF OPHTHALMIC INFLAMMATION.

As many of the most important diseases of the eye consist either in inflammation itself, or in its effects, and as all our operations on the organ must be regulated by the kind and degree of inflammatory reaction we expect to follow, an accurate knowledge of the ophthalmiæ must ever be considered the master-key of our subject, and worthy, therefore, of the most particular attention of the practitioner.

SECTION I.—INFLAMMATION IN GENERAL.

In entering on the study of ophthalmic inflammation, it will be useful to call to mind the following particulars respecting the nature of the phenomena of the inflammatory process in general:—

§ I. INFLAMMATION PROPER.

The first step in inflammation proper, is *congestion*—the second, *increased exudation.* Congestion is manifested by *preternatural redness*, which is owing to the stagnation and accumulation of red blood-corpuscles in the small vessels. Exudation from the blood, first of serum, subsequently of ymph in increased quantity, supervenes, as an effect of he congestion; and is manifested in different ways, according to the structure of the part affected, *e. g.* by *welling, thickening, opacity, phlyctenulæ, pustules, discharge,* &c.

None of the corpuscles of the blood escape along with he exuded plasma, but a rupture of some of the congested essels may occur, in which case, there is *extravasation of* *blood*, which is manifested either by actual hæmorrhage, or the infiltration of the tissue in the form of ecchymosis, &c. The redness of ecchymosis is in general readily distinguished from that of vascular congestion.

With exudation is completed the inflammatory process properly so called.

§ II. TERMINATIONS OR EVENTS OF INFLAMMATION.

Inflammation terminates either in the healing process or in mortification.

As congestion and exudation are the essential steps of inflammation proper, so re-establishment of the circulation, and absorption of the exuded matter, manifested by the disappearance of the redness, subsidence of the swelling, &c., constitute the most direct termination in recovery, viz., *Resolution.*

In cases in which there is solution of continuity, the healing process is not so direct, and the exuded matter plays a more important part. It is converted into new tissue, by which the wound is united or filled up, according as the circumstances are such as to permit of "adhesion" or "healing by the first intention;" or only of "granulation with suppuration," that is, "healing by the second intention." The congestion and exudation, and therefore the redness and swelling of the part, do not cease on the occurrence of either of these forms of the healing process. They continue until the wound is cicatrised, the congestion being the necessary condition of exudation; the exudation, again, that of the supply of material wherewith regeneration is effected.

When mortification takes place, the dead part tends to be thrown off in the form of a slough. The separation is effected by a process of softening of the dead part, and the establishment of suppuration at the surface of the living where there is congestion.

The process of *ulceration* is the opposite of that of *granulation.* For whereas in a granulating sore the exuded matter is developed partly into tissues, partly into pus; in an ulcerating sore the exuded matter is not only not organised into new tissue, but that of the affected part loses its vitality, and is thrown off in minute portions from the surface along with the discharge, which is either a mere sanies, or at the most an imperfectly developed pus. From this it is seen that *ulceration* belongs to the head of *mortification*.

The phenomena of inflammation and its events above described are *objective*, or such as admit of being observed by the surgeon. The *subjective* phenomena, or those which the patient alone perceives, are the pain and other morbid sensations. The heat which attends inflammation is at once both objective and subjective.

The *objective increase of heat*, or that actual increase ascertainable by the thermometer, is owing to the congestion. The *subjective increase of heat*, or the patient's sensation of increased heat, depends partly on the objective increase, and partly on the exalted susceptibility of the sensitive nerves of the affected part.

The *pain* which may occur at first is a manifestation of the increased sensibility of the sensitive nerves occasioned by the exciting cause of the inflammation. The aggravation and new kinds of pain which supervene are owing to the irritation of the nerves, already in a state of excitement, produced by the pressure exerted by the congested vessels and exuded matter. Other parts than that which is the immediate seat of the inflammation, may be sympathetically affected.

§ III. DISTINCTION OF INFLAMMATION INTO ACUTE AND CHRONIC.

Acute and chronic inflammations are so named from the most striking parts of their character,—the former being distinguished by severity of symptoms, the latter by long continuance. In the acute form of inflammation, with severity of symptoms, there is combined rapidity of progress; and in the chronic form, long continuance is tempered by mildness of symptoms.

These differences, it will be observed, are merely differences in degree and continuance. There does not appear to be any essential difference in nature between the acute and chronic forms of inflammation. In both there is congestion, in both exudation, and in both the exuded matter undergoes analogous changes. Moreover, it is to be observed, that between well-marked acute and well-marked chronic inflammation, all intermediate forms are met with.

The conditions on which the striking parts of the character of acute and chronic inflammation appear to depend, are respectively the following:—

In acute inflammation the congestion is greater; and if resolution, to which there is a tendency, does not soon ensue, exudation of lymph takes place more or less copiously, the result of which is adhesion, or abscess, or thick puriform discharge, as the case may be, after which the circulation may gradually become re-established, and so there is an end of the inflammation.

In chronic inflammation, on the contrary, the congestion is less complete—there is but little tendency to resolution—and exudation is either not so copious within a given time, or it is more watery. Moreover, the congestion persists, and the exudation still goes on, the result of which is hypertrophies, gleets, &c., as the case may be, and eventually, in some cases, atrophy.

Chronic inflammation may either succeed to acute inflammation, or come on slowly of itself, unpreceded by any acute stage. Acute inflammation may supervene on chronic inflammation.

SECTION II.—OPHTHALMIC INFLAMMATION IN GENERAL.

As inflammation is seldom or never confined to a single structure of the eye, but generally involves several at the same time, so a description of inflammation in individual structures would be, as has been remarked by a distinguished writer on the subject, a description of a state which seldom or never presents itself separately in nature. Notwithstanding this, it will be useful to premise an abstract account of the characters peculiar to inflammation of individual structures, preparatory to entering upon the study of the varied combinations which actually present themselves in practice. Our descriptions of those combinations will thus admit of being given both more briefly and more clearly.

§ I. INFLAMMATION AS IT OCCURS IN THE DIFFERENT STRUCTURES OF THE EYE.

In discussing this subject, I will first consider the objective phenomena of inflammation of the different structures of the eye, and then the subjective phenomena.

A. OBJECTIVE PHENOMENA.

1st. *Conjunctivitis, or inflammation of the conjunctiva.*

The principal forms of inflammation, of which the conjunctiva may be the seat, are pustular, catarrhal, purulent, pseudo-membraneous, and erysipelatous.

Pustular inflammation.—A small, often apparently isolated, spot of vascular injection, and slight swelling, of the sclerotic conjunctiva at some little distance from the margin of the cornea, with a flake of matter in the middle. Such are the manifestations of the congestion and consequent exudation in this most simple form of conjunctival inflammation.

In consequence of its little cohesion, the epithelium of the conjunctiva scleroticæ does not, like the epidermis of the skin, retain the matter exuded underneath it, but gives way, leaving an abrasion covered with the flake of exuded matter, now become pus or puriform.

Besides the red spot from vascular congestion, there may be patches of ecchymosis.

The inflammation extending, the continuity of the vessels of the spot of inflammatory injection with those of the rest of the conjunctiva, often at first not distinguishable by the naked eye, comes to be distinctly visible. By-and-by, inflammatory injection of the conjunctiva generally may supervene, but the injection continues greatest in the region of the pustule or the abrasion or ulceration of surface left by it. Some puromucous secretion attends this extension of the inflammation as the result of the increased exudation. In such a case, it may be said that to the pustular, catarrhal inflammation has been superadded.

The ophthalmia now described, affords an example of inflammation, and the healing process in their simplest manifestation. It will be useful, therefore, to analyse the phenomena in illustration of what has been above said of inflammation in general.

Inflammatory injection, as observed in the web of the bat's wing or frog's foot under the microscope, consists in an accumulation or congestion of red corpuscles in the blood, within the minute vessels of the affected part. The blood loaded with the accumulated red corpuscles may, in some of the vessels, still be flowing, though sluggishly, like a thick viscid matter; but in most of the vessels the accumulated red corpuscles are closely agglomerated together, and being adherent to their walls block them up, so that the blood is stagnant within them. The vascular injection of the inflamed conjunctiva in man, as observed with the naked eye, or by means of a magnifying glass, resembles in its characters, the vascular injection in inflammation of the web of the bat's wing or frog's foot as observed by the same means. For this reason, and seeing that the plan of distribution of the smallest vessels in man appears to be similar to that of the distribution of the smallest vessels in the bat or frog; moreover, knowing that the red corpuscles of the blood of man agglomerate together as readily as those of the bat, and much more readily and closely than those of the blood of the frog, we may fairly conclude, that in the vessels of an inflamed part in man, the red corpuscles of the blood are accumulated and aggregated together in a manner similar to that in which we can directly observe them accumulated and agglomerated in the web of the bat or frog. Indeed, if we were to judge from the comparative examination of detached parts of the human body, and of the frog in a state of inflammation, after death, we should expressly affirm the proposition.*

Pustular ophthalmia is usually excited by exposure of the eye to a draught of air. As to the mode of action of this cause. It is to be observed that the effect of the direct action of cold in the small arteries of a part, is vital contraction of their walls and constriction of their calibre; and it is also to be observed, that when all the arteries of a part are more or less constricted, there is sluggish flow of blood, with great accumulation of red corpuscles in the capillaries and veins, and here and there stagnation. A similar state of the blood and the bloodvessels to that here mentioned, is the only possible one which we can conceive as the first step to inflammation of a part of the human body from the direct action of cold on it. The bluish redness of the affected part, indicates great accumulation of red corpuscles in the blood in the venous radicles,—a state which, under the circumstances, can be owing only to constriction of the small arteries, whereby *vis a tergo* is diminished, and blood loaded with red corpuscles thus allowed to regurgitate into and accumulate in the small veins and capillaries.

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* "On the State of the Blood and the Blood-vessels in Inflammation." In Guy's Hospital Reports, for October, 1850.

The apparent isolation from all connexion with any neighbouring vessels which the spot of injection in pustular ophthalmia often presents, I infer, from what I have observed, to depend on the following conditions:—

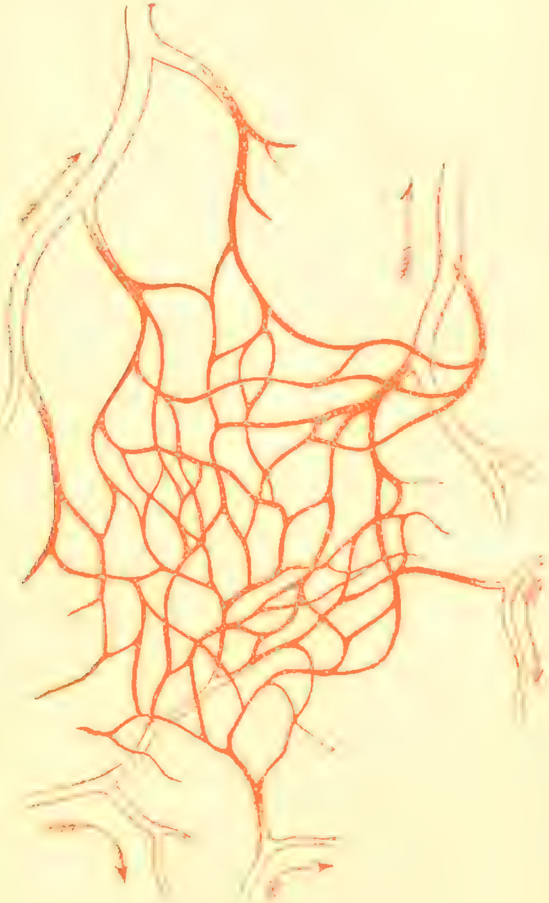

Fig. 24.

1st. *On the side of the arteries.*—The artery or arteries immediately leading to the injected spot are invisible to the naked eye, being empty of blood on account of their constriction and the stream from their feeder passing off by a lateral branch at some distance from the spot. Besides, such small arteries are invisible to the naked eye unless gorged with accumulated red corpuscles.

2nd. *On the side of the veins.*—Those veins with which the venous radicles of the injected spot of conjunctiva communicate, are invisible to the naked eye in consequence of their not being gorged with accumulated red corpuscles, though having the flow of blood still free in them. See diagram in preceding page.

The increase of the inflammation around the original spot, I infer to be owing, on the one hand, to the supervention of dilatation of the arteries leading to it, when that dilatation fails to produce resolution, allowing a greater quantity of blood loaded with red corpuscles to be poured into the vessels of the affected part than can escape, in consequence of the pre-existing obstruction from stagnation, and on the other hand to extension of stagnation in the veins leading from the affected spot. The extension of the inflammation to other parts of the conjunctiva, I infer to take place by the same process as that which led to the inflammation in the first instance as above described.

The thickening of the conjunctiva in the situation of the injected spot, and especially the pustule or flake of matter in the middle, are manifestations of the exudation which has supervened on the inflammatory injection.

Healing process in pustular inflammation of the conjunctiva.—In cases left to themselves, we often find along with increase of the inflammatory congestion, the abrasion or superficial ulceration of the conjunctiva extended. But under the influence of irritating applications to the eye, the vascular injection speedily disappears, and, *pari passu*, healing of the abrasion or superficial ulceration takes place, the surface becoming covered with a new epithelium, whilst the flake of puriform matter is thrown off.

In regard to the mode of action of irritating applications in conjunctival inflammation, the following explanation is given in the essay already cited.

"We have above seen reason to conjecture that inflammation of the conjunctiva, for example, from cold or from the irritation of a foreign particle in the eye, commences by constriction of the small arteries, which allows of the blood corpuscles to accumulate in the capillaries and venous radicles. That in such a case, resolution is owing to dilatation of the arteries and coincident acceleration of the flow of blood, we have above seen equal reason to conjecture. Nay, we have above shewn, by experiment on the frog, that dilatation of the arteries, and the coincident acceleration of the flow of blood, are the first steps to resolution of inflammation,—an experiment, let it be repeated, which is an interesting illustration of the *modus operandi* of stimulating collyria, applied to the eye for the cure of catarrhal ophthalmia."

The cases of ophthalmia in which pustules present themselves quite at the margin of the cornea are not of so simple a character as that above described, but constitute a transition to phlyctenular or common scrofulous ophthalmia. The injected vessels extend to the pustules, in fasciculi from the corresponding side of the sclerotic conjunctiva. The thick epithelium of the cornea is at the part opaque and slightly raised by the exuded matter which, with the softened epithelium of the sclerotic conjunctiva of the spot affected, forms, as in the preceding case, the small yellow flake. This form of pustule thus presents a character intermediate between the phlyctenula or pustule of the cornea and the abraded spot of the sclerotic conjunctiva above described.

Catarrhal inflammation of the conjunctiva.—(Plate I., fig. 1.)—The conjunctiva of the eyelids and of the palpebral sinuses, is deep red. The conjunctiva oculi is also deep red at its circumference, but towards the cornea the redness is, at the commencement of the inflammation, gradually shaded off; when, however, the inflammation is fully established, the redness extends even to the margin of the cornea.

The injection of the highly developed capillary network of the palpebral conjunctiva gives rise to a uniform and intense redness, concealing from view the larger subjacent vessels. Except in a very high degree of inflammation, the injection of the less developed capillary network of the sclerotic conjunctiva does not conceal the larger subjacent vessels. Indeed, what most strikes the observer, is the network with large meshes formed by the intercrossing and inosculation of comparatively large and tortuous vessels, the ramifications of which tend towards the margin of the cornea. These vessels are the arteries and veins which carry the blood to and from the superficial capillary network—veins especially, for the arteries are rather constricted, and, therefore, not so apparent.

In consequence of the accumulation of blood in its vessels, the conjunctiva is thickened. The papillæ of the palpebral conjunctiva, being for the same reason swollen and erect, the inner surface of the eyelids has a velvety appearance.

The conjunctiva covering the caruncula lacrymalis, and forming the semilunar fold, is deep red, like the palpebral conjunctiva, and being at the same time thickened by the accumulation of blood in its vessels, both the lacrymal caruncle and semilunar fold appear much enlarged.

At the commencement of the inflammation, a serous exudation takes place from the surface of the conjunctiva. By-and-by a puromucous discharge, the presence of which is an important character of the inflammation, is established. On everting the lower eyelid, a flake of exfoliated conjunctival epithelium with puromucus is generally seen in the lower palpebral sinus.

The eyelids, besides being somewhat red, are more or less swollen, from serous exudation into their cellular tissue. There may also be exudation into the cellular tissue underneath the sclerotic conjunctiva, raising it up like a wall round the cornea, constituting *chemosis*. Tumefaction of the eyelids and chemosis are analogous in their nature and mode of production to that swelling which takes place in the neighbourhood of any active inflammation.

Ecchymotic spots sometimes present themselves, especially over the sclerotica, in consequence of extravasation of blood into the substance of the sclerotic conjunctiva, or into the cellular tissue underneath.

Healing process in catarrhal inflammation of the conjunctiva.—As vascular congestion, or in other words, the redness diminishes, the seromucous or puromucous discharge becomes less and less, and any accompanying chemosis and swelling of the eyelids subside. It is to be remarked, that the vascular congestion of the palpebral conjunctiva disappears less quickly than that of the ocular conjunctiva.

Purulent inflammation of the conjunctiva.—Here we have all the phenomena of catarrhal inflammation in an aggravated degree,—the vascular injection more intense, the discharge more copious and purulent, the swelling of the eyelids and chemosis greater. There may be actual discharge of blood from the surface of the conjunctiva.

From the description now given of purulent inflammation of the conjunctiva, it appears that the matter which is exuded from the inflamed surface is converted into pus, though the surface is not ulcerated. On the other hand, the lymph which may have been exuded into the substance of the membrane is developed into tissue, which is the cause of that thickening of the palpebral conjuctiva, and enlargement of its papillæ, which remain for a greater or less length of time, or even permanently, after the inflammation has subsided.

Granular conjunctiva.—This morbid condition is peculiar to the conjunctiva of the eyelids, palpebral sinuses, and semilunar fold. It is a distinguishing character of that inflammation of the conjunctiva which prevails in workhouses, barracks, &c., usually chronic, but liable to accessions of acute conjunctivitis termed "relapses," and under favouring conditions running into the violent purulent ophthalmia.

One form of "granulations" of the conjunctiva appears to consist simply in hypertrophy of the papillæ of the palpebral conjunctiva investing the tarsal cartilages. (Plate I., fig. 2.) Sometimes they give a tuberculated aspect to the inside of the eyelid; sometimes they are large and pedunculated like small polypi.

What we may call the specific granulations of the conjunctiva present themselves as unelevated yellowish points in the red and thickened conjunctiva over the tarsal cartilages; but in the palpebral sinuses they have the form of more or less elevated phlyctenulæ. (Plate II., fig. 1.) Just within the edges of the eyelids, also, they are met with of the phlyctenular form, arranged in a row. These phlyctenular-like granulations are produced by exudations into the substance of the conjunctiva. The exuded matter is found at a certain stage, softened, and in the form of a greyish matter, consisting of microscopic cells in different phases of development, and even newly-formed capillary vessels. In a more advanced stage, the phlyctenulæ are found to have burst, and the matter oozing out from them. In this stage we find something like real granulations rising from the bottom or edges of the burst phlyctenulæ.

Pseudo-membraneous exudation on the conjunctiva.—In inflammation of mucous membranes it is well known that the matter exuded on the surface is sometimes found in the form of false membranes. This matter, however, does not, like that exuded by serous membranes, become organised into tissue; such false membranes are usually separated and thrown off.

In ophthalmitis exuded lymph like what is found in diphtheria sometimes presents itself on the white chemosed conjunctiva. Pseudo-membraneous exudation on the palpebral conjunctiva also sometimes presents itself in cases of severe purulent ophthalmia in children; as well as in a peculiar form of inflammation of the conjunctiva and edges of the eyelids, distinct from ordinary ophthalmia neonatorum, sometimes met with in congenitally syphilitic infants.

Fibrinous exudation not only *on*, but also *in* the interstices of, the conjunctiva, is described as the characteristic of the diphtheritic ophthalmia to which attention has, of late years, been drawn, especially in Germany, and of which a "diphtheritic epidemic constitution" of the atmosphere is said to be the chief predisposing cause.

The coagulation and exfoliation of the epithelium, especially of the cornea, in consequence of chemical injuries, must not be mistaken for pseudo-membraneous formation.

Erysipelatous inflammation of the conjunctiva.—The most remarkable appearance in this ophthalmia is the serous exudation under the sclerotic conjunctiva, whereby the latter is raised up in folds which protrude like vesicles between the eyelids. The conjunctiva is of a light red colour, inclining to yellow, and presents here and there spots of ecchymosis, but few individual vessels are readily discernible. The mucous secretion of the conjunctiva is somewhat increased in quantity.

Mortification and ulceration of the conjunctiva.—In certain cases of inflammatory chemosis, sloughing of the conjunctiva is met with. Sloughing of parts of the conjunctiva, in consequence of chemical injury, is of common occurrence. Ulceration, except from a specific cause, seldom takes place. In a phthisical girl I found a sloughy ulcer of the conjunctiva of the lower palpebral sinus, extending to the palpebral conjunctiva on the one hand, and to the ocular conjunctiva on the other. It at first showed little disposition to heal, and when it did so, the contraction of the conjunctiva which resulted, caused inversion of some of the eyelashes and a large frenum between the eyelid and eyeball. The other eye afterwards became affected in the same way.

Healing of wounds of the conjunctiva.—Wounds of the conjunctiva readily heal, as is exemplified after the operation for squint. The conjunctiva becomes injected at the edge of the wound, and lymph is exuded, which becomes organised in the manner already explained, according as the union is by the first or second intention, one or the other event being in general determined by the apposition or non-apposition of the edges of the wound, as in the skin.

The palpebral and ocular surfaces of the conjunctiva, though inflamed, have no tendency to form adhesions even while kept in close apposition, unless previously made raw. When abrasion of the surfaces has been produced by ulceration, and especially by burns and escharotics, there is then great tendency to the formation of adhesions with resulting *symblepharon.*

Atrophy of the conjunctiva.—We have an example of this in cuticular conjunctiva, or conjunctival xeroma, in which the conjunctiva is so changed in structure, that its epithelium, the epithelium of the cornea included, is thickened, dry and semiopaque, like epidermis, its natural mucous secretion suppressed, while there is general contraction of the whole conjunctiva, even to obliteration of the palpebral sinuses. Atrophy of the conjunctiva is commonly the effect of some external ophthalmia, which, by neglect or mistreatment, has been allowed to fall into a chronic state.

2nd. *Sclerotitis, or inflammation of the sclerotica.*

The redness is in the form of a pink or lake-coloured zone, encircling the cornea; the injected vessels of the sclerotica being very minute, and disposed in straight radiating lines. The tint is deeper at the margin of the cornea, whilst it is shaded off, and disappears towards the orbit—the converse of what occurs in the injection attending conjunctival inflammation. See diagram at page 19.

If the vascular congestion be alone taken as inflammation, then it must be said that the part of the sclerotica visible during life through the conjunctiva, is often inflamed; but if exudation, and the changes which the exuded matter undergoes, be rather assumed to be indicative of inflammation, then it must be admitted that the sclerotica is comparatively rarely the seat of inflammation.

Fibrous tissues in general do not appear to be more frequently the seat of the effects of inflammation than the sclerotica, but are they not as frequently the seat of vascular congestion? Is rheumatism anything more in most cases than vascular congestion in fibrous tissues, with, perhaps, serous exudation into neighbouring parts? What is called rheumatic ophthalmia appears to be at least nothing more than inflammatory congestion of the sclerotica, usually with more or less implication of the cornea and iris.

Rheumatism, or inflammatory congestion in fibrous structures, may at last lead to exudation of lymph either into the substance or on the surface of the part affected—in the one case giving rise to the thickening and induration of the fibrous structures, in the other, to effusions into the joints or adhesions, such as are met with in pericarditis. By repeated congestions, the sclerotica is indeed left in a somewhat altered state, but it is the cornea or iris, when it is the anterior segment of the eye which is involved, which is principally the seat of exudation of lymph and the changes consequent on it, as the joints are in articular rheumatism.

Pink vascular injection, with thickening and elevation of the sclerotica in patches adjacent to the cornea, chiefly at the nasal, temporal, upper and lower margins, where the recti muscles are inserted, I have met with in scrofulous children from eight to twelve years of age, and in rheumatic adults, especially females. Though there was some conjunctival injection at the place, and slight dimness of the cornea supervened, the sclerotica and tendinous insertions of the recti muscles appeared to be the parts principally affected. Recovery took place slowly under treatment, the congestion disappearing and the thickening subsiding.

The most marked example, perhaps, of the tissue of the sclerotica becoming the seat of changes from inflammation occurs in sclerotico-choroiditis. The first change is a thickened and fleshy appearance: but its texture becoming at the same time softened, the sclerotica by-and-by yields to the distension from within the eye, protrudes and becomes attenuated, and of a dark colour (*sclerotic staphyloma*). Plate IV. fig. 2.

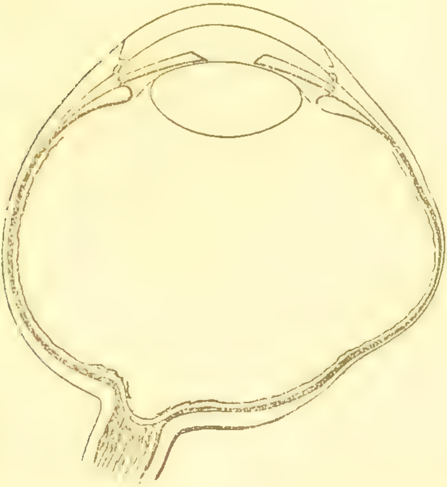

FIG. 25. Diagrammatic Section of an Eye affected with Sclerotic Staphyloma.

In some cases, however, instead of becoming attenuated and dark, the affected part of the sclerotica actually becomes thickened, and of a dense white pearly aspect.

Healing process.—Incised wounds of the sclerotica heal by a firm cicatrice, as in the case of other fibrous tissues.

Mortification and ulceration of the sclerotica.—Such do not appear to occur as results of ordinary sclerotitis. In a case referred to in a late number of the Ophthalmic Hospital Reports, in which a piece of the conjunctiva was excised all round the cornea, and the nitrate of silver thereafter applied to the eye, a part of the sclerotica sloughed.

3rd. *Corneitis, or inflammation of the cornea.*

The cornea, though vascular whilst being developed, is in its fully-formed and healthy state non-vascular, and yet inflammation of the cornea is spoken of.

The cornea, there is reason to believe, derives the materials necessary for its nutrition from the blood circulating in the vessels of the adjoining parts of the conjunctiva and sclerotica. Let us inquire what takes place in the cornea when it suffers such injury as would excite inflammation in one of the vascular parts of the eye.

When the cornea is injured, then, congestion of the vessels of the adjoining parts of the conjunctiva and sclerotica takes place, and exudation into the substance of the cornea by-and-by ensues. Thus, though non-vascular, and, of course, not the seat of the inflammatory congestion, it becomes the seat of a very important part of the inflammatory process—the most important part, perhaps, as regards the events of the process.

The cornea in this state may therefore be said to be, to all intents and purposes, inflamed—the only difference in respect to it, as compared with vascular parts, being, that the vascular congestion is *not in it*, but in *adjoining structures*.

On the other hand it is to be remarked, that although these adjoining structures are the seat of the congestion, little or no exudation may take place in them or on them, and they may therefore be said to be scarcely or not at all the seat of inflammation as regards the events of the process. When the conjunctiva and sclerotica are really inflamed, exudation in or on them may occur, but then the congestion is different in seat and extent from what it is when the cornea is the seat of the inflammation, and there may be no exudation into the cornea—the cornea may remain unaffected.

In the progress of inflammation in the cornea, this structure may become vascular, but such an event is owing to the development of new vessels, such as also happens in inflammation of vascular parts.

Though inflammation of the cornea, considered as a non-vascular part, has been thus dwelt on, the truth is, that all tissues, as regards their component elements, are, properly speaking, non-vascular, and differ from the cornea only in the degree of proximity to the vessels, and therefore in inflammation only in the degree of proximity to the source of the exudation.

But this very difference in the case of the cornea affords a natural analysis of the inflammatory process. It enables us to observe, separately, the two great stages of inflammation proper—the *congestion* and *exudation*—the congestion in one place, the exudation in another. It also enables us to observe, in an uncomplicated manner, the eventual stages of inflammation, such as re-organisation and suppuration.

That the cornea is the seat of exudation is manifested by opacities of various kinds, phlyctenulæ, and abscesses. When new vessels are developed in the exuded matter, the cornea then becomes the seat of more or less redness. This, however, is to be distinguished from that which may result from effused blood. When effusion of blood occurs, it appears usually in a patch near the edge of the cornea.

When resolution of inflammation of the cornea above referred to takes place, the irritability of the eye ceases, and, on the one hand, the congestion of the neighbouring conjunctiva and sclerotica diminishes; then, on the other, the exudation in the substance of the cornea disappears.

The cornea has been just referred to as a part which, from its non-vascularity, forms a good subject for observing, in a manner uncomplicated by the presence of the vessels in which the blood is stagnant, the development and disposition of the exuded matter in the healing process. The matter exuded into the substance of the cornea from the vessels of the adjacent conjunctiva and sclerotica may (as far as examination with the naked eye, or the eye assisted merely by a magnifying glass goes) be seen to undergo the different modes of development above described.

It may be seen that pustules form, and that, in the healing of incisions and ulcers of the cornea, adhesion and granulation, and, lastly, cicatrization, may take place without the development of new vessels—a convincing proof that neither suppuration nor "organization" necessarily implies the development of new vessels.

But, as above hinted, new vessels may be formed in the matter exuded into the cornea, and this again affords a very interesting and readily observable example of the development of new vessels, uncomplicated by the previous existence of other vessels in the part.

The new vessels, having served their purpose, shrink and disappear, and it is usually not until this has taken place that cicatrization is completed.

One or other of the three principal layers of the cornea may be more particularly the seat of the exuded matter; hence are distinguished inflammation of the proper substance of the cornea, of the conjunctiva corneæ, and of the membrane of Descemet.

Inflammation of the proper substance of the cornea.—In inflammation of the proper substance of the cornea, the vascular congestion is seated in the sclerotica in the form of the sclerotic circumcorneal zone, but sometimes the redness is very slightly marked. There is generally also congestion of the circumcorneal network of the conjunctiva.

The exuded matter is deposited either in the interstices of the tissue or on its surface, in the latter case, raising the epithelium in the form of a phlyctenula.

The exudation into the interstices of the proper substance of the cornea, may produce map-like patches of dimness and nothing more. Or the exudation being in greater quantity, a general greyish or yellowish-white opacity results, denser at some points than others, and intermixed with red from the presence of new vessels. In this case, the cornea presents a peculiar opalescent appearance.

In certain cases there is less exudation and development of vessels; the cornea still retains a degree of transparency, but is of a dirty yellowish-green colour, and rough like ground glass, owing to minute vesicles on its surface, or minute points of ulceration, resulting from the bursting of the vesicles. There is softening of the cornea in all these cases.

When exudation into the proper substance of the cornea, or under the epithelium, takes place rapidly and copiously, the exuded matter is generally formed into pus or puriform matter, and the result is an abscess or a pustule. In such cases the inflammation is more of an acute character than in the preceding. There is more vascular congestion in the conjunctiva and sclerotica, so much so, that the cases in question are commonly viewed as examples of corneitis supervening on inflammation of the conjunctiva and sclerotica, while the preceding cases are, on account of the slight appearance of congestion in the conjunctiva and sclerotica, viewed as examples of primary corneitis. But from what has been above said of inflammation of the cornea, there is no *primary corneitis* in the sense here implied, *i. e.* with vascular congestion first in the cornea.

The depositions of yellow matter which occur in the interstices of the cornea at its lower part, which, on account of their presenting the form of the lunular spot at the root of the nails, are called *unguis* or *onyx*, and which are in general rapidly absorbed as the attendant inflammation is subdued, have not the character of abscesses like the circumscribed collections of matter which form in the centre of the cornea. The latter appear as a densely opaque spot, first white, then yellow, around which the rest of the cornea is more or less opaque from exuded lymph, in which there may be new vessels, as in the walls of abscesses elsewhere. Compare this diagram of the position of the matter in onyx with that at p. 121, representing the position of the matter in hypopyon.

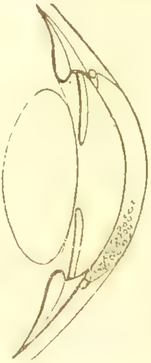

FIG. 26.

Most frequently the exuded matter is deposited on the surface of the proper substance of the cornea, raising the epithelium in the form of a phlyctenula or blister. The epithelium of the cornea being denser, thicker, and more coherent than that of the sclerotic conjunctiva, confines the matter which is exuded, in much the same way that the epidermis of the skin does. The matter being at first a transparent fluid, there is a phlyctenula; subsequently becoming puriform or purulent, there is a pustule. Often the process does not proceed so far as the formation of a pustule.

A phlyctenula or pustule of the cornea having burst, a small ulcer covered with purolymph is left, which may be compared to the spot on the sclerotic conjunctiva in pustular ophthalmia. A fasciculus of new vessels, extending to this ulcer from the conjunctival circumcorneal network, may make its appearance. (Plate I., fig. 3.)

Healing process in inflammation of the proper substance of the cornea.—When the congestion around the cornea subsides, the matter exuded into its substance may gradually be absorbed,—and this even when development of it has gone on to the formation of new vessels,—though tardily; for the more the exuded matter has been developed, the less readily does it dissolve and become fitted for absorption. The new vessels first disappear, leaving a greyish-white opacity, which clears away from the circumference towards the centre of the cornea, where often more or less opacity remains.

A pustule on the surface of the cornea, or an abscess in its proper substance, may disappear by absorption of its contents, leaving, however, more or less opacity; but these collections of matter usually burst, and leave a sore, which may either commence to heal by granulation or run into ulceration.

Inflammation of the conjunctiva corneæ.—This usually accompanies acute inflammation of the proper substance of the cornea, or is an extension of inflammation of the sclerotic conjunctiva.

In consequence of the exudation, the conjunctiva corneæ becomes at some point opaque and thickened, and here new vessels are soon formed, which, connecting themselves with the conjunctival circumcorneal network—which at the place is in a state of congestion—appear as a mere extension of a fasciculus of vessels from it. The opacity and vascularity may gradually spread over the cornea.

In some cases of what may be called inflammation of the conjunctiva corneæ, there are fewer new vessels and less opacity, but there is superficial spreading ulceration. In certain cases the cornea presents here and there on its surface vascular fungous granulations.

The changes which the conjunctiva corneæ undergoes in inflammation, the thickening and vascularity, are very apt to remain in the forms of pannus, vascular cornea, &c. (Plate II., fig. 1); but often they disappear entirely, and the cornea resumes its natural appearance.

Inflammation of the membrane of Descemet.—In this inflammation, the vascular congestion is in the sclerotic zone. The exuded matter is deposited between the proper substance of the cornea and the membrane, and generally presents itself in the form of scattered punctiform opacities. Here also new vessels, when formed, make their appearance.

As the inflammatory congestion subsides, the exuded matter is removed by absorption.

The matter of hypopyon would appear to be sometimes the result of exudation with exfoliation of the epithelium from the inner surface of the membrane of Descemet.

Ulceration of the cornea.—The cornea is extremely prone to ulceration. The ulceration may be limited to a mere abrasion or exfoliation of the epithelium, or it may affect the proper substance of the cornea also. The membrane of Descemet does not appear to be liable to ulceration; but when exposed and deprived of support by penetrating ulceration of the proper substance of the cornea, it eventually bursts.

Abrasion of the epithelium presents itself either in that form, in which its substance looks like ground glass, or in a form like what is presented after death, when the epithelium begins to soften, and portions of it are detached by wiping the surface. The first form occurs in inflammation of the proper substance of the cornea. The second is rather a result of inflammation of the conjunctiva corneæ; there is superficial vascularity, and the abrasion, like ulceration, has a great tendency to spread; but while it spreads on one side, cicatrization may be seen taking place on another. The cicatrization gives rise to slight opacity.

Ulceration of the proper substance of the cornea generally commences by the bursting of an abscess or phlyctenula. Both the bottom and edges of the ulcer may be clear, and the cornea around scarcely, if at all, nebulous. In other cases the bottom of the ulcer is filled with a grayish sloughy-looking matter, which is thrown off to be succeeded by the same thing, whilst the ulcer goes on increasing in depth, and may at last completely perforate the cornea.

Hernia of the cornea—(*Keratocele*).—When an ulcer has penetrated through the proper substance of the cornea, the membrane of Descemet, unable to withstand the pressure from within, is protruded at the bottom of the ulcer, in the form of a small vesicle filled with aqueous humour (Fig. 27). This hernia of the cornea, or rather prolapse of the membrane of Descemet, usually bursts ere long; the aqueous humour is thus allowed to escape, whereupon the iris falls forward into contact with the cornea, and perhaps a prolapse of it takes place through the ulcerated opening in the cornea (Fig. 28).

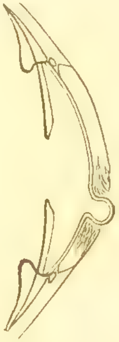

Fig. 27.

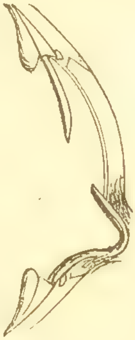

Fig. 28.

If now a remission of the attending inflammation occurs, which is apt to happen, in consequence of the relief of tension produced by the evacuation of the aqueous humour, the ulcerated opening in the cornea heals, the aqueous humour again accumulates, and the iris returns to its natural position, provided no prolapse of it had taken place.

In some cases, when ulceration of the cornea is both broad and deep, but not penetrating entirely through the proper substance, the hernia of the cornea which takes place is large, but still invested with some of the corneal tissue. In consequence of this it does not so readily burst, but may remain permanent as a thinned and projecting part of the cornea, with impaired transparency, resembling somewhat conical cornea, from which, however, it is to be distinguished. From partial staphyloma it differs in not being connected with the iris, and never being so opaque (Fig. 29).

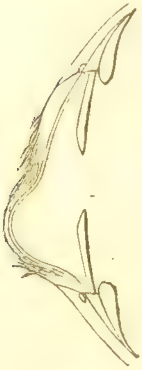

Fig. 29.

By the bursting of an abscess or onyx of the cornea inwards into the anterior chamber, the membrane of Descemet, and the inner part of the corneal substance, are destroyed; the outer part, then, incapable of withstanding the pressure from within, sometimes yields, and forms a prominence of a conical shape.

Mortification of the cornea.—The complete death of the cornea, and the separation of it in the form of a well-marked leathery slough, is of rare occurrence. The destruction of the cornea, which is so common in the purulent ophthalmiæ, takes place in a different manner.

The cornea, overlapped all round its margin by the chemosed conjunctiva, may be observed to continue for some time unaffected; but within a short interval it will be found to have become quite opaque and softened. To this succeeds the process of destruction, which consists in that form of mortification, with small sloughs, which constitutes ulceration. The destruction may involve the whole cornea in its whole thickness, or a part only in its whole thickness; or it may involve a superficial portion only, and this of greater or less size.

The immediate cause of all this mischief appears to be the infiltration of the substance of the cornea with exuded matter, and the mechanical pressure exerted by the chemosed conjunctiva and swollen eyelids, whereby the nutritive movements are more or less completely arrested.

Healing of wounds and ulcers of the cornea—by the first intention.—A simple incision of the cornea in general heals readily. From the vessels of the conjunctiva and sclerotica, which are congested on that side of the cornea next the wound, lymph is exuded into the cornea at the seat of the wound, producing opacity to a greater or less extent, and of more or less intensity. The cut edges are agglutinated by the exuded lymph, and by its organization continuity of structure is restored. What of exuded matter remains in the substance of the cornea, producing opacity, is gradually absorbed, and the cornea clears in proportion as the injection of the conjunctival and sclerotic vessels subsides; a small speck perhaps, the cicatrice, merely remaining. No new vessels may have been formed in the cornea.

By the second intention.—Loss of substance of the cornea, whether produced by ulceration or otherwise, is restored by granulation. The granulations may be non-vascular, or they may be vascular, from new vessels which have been developed in the exuded matter, and which have formed a connexion with those of the neighbouring conjunctiva and sclerotica. These new vessels generally disappear when the process of granulation is completed, and preparatory to cicatrization. Thus, when an ulcer has filled up by vascular granulations, one vessel after another disappears, until all are gone, leaving an opaque streak where their course in the cornea had been.

At first the sore may be swollen, and more or less nebulous at the edges, and discharge a tough, yellow, puro-lymphy matter, which sometimes adheres to it, and hangs down from it in flakes. But when the ulcer begins to heal, its edges become decidedly gray and opaque, and in proportion as it is filled up with granulations, the quantity of puro-lymphy matter discharged from it diminishes, until none at all is formed. At last cicatrization takes place, and the surrounding nebulosity diminishes until it disappears altogether.

The cicatrice is either a permanently opaque spot (*leucoma*) or it is a clear facet, presenting the appearance as if a small piece had been sliced from the convex surface of the cornea.

Effects of penetration of the cornea.—When the cornea is freely penetrated by wound, ulceration, or sloughing, prolapsus iridis takes place.

According to the size and position of the opening in the cornea, so is the extent of the prolapse of the iris, and so is the pupil more or less involved. The different degrees of prolapsus iridis have received different names; thus, when small it is called *myocephalon*, from its forming a small black point like the head of a fly;—when it is a little larger, and flattened down by the pressure of the eyelids, it has been compared to the head of a nail, whence the name *clavus;*—when larger and more prominent, it has been called *melon*, or apple-shaped prolapse. When the iris is protruded at several openings, or when, in consequence of extensive destruction of the cornea, it is almost wholly protruded, but is bound by adhesions to the capsule behind, the appearance is somewhat like that of a bunch of grapes, whence the name *staphyloma racemosum* (Fig. 30).

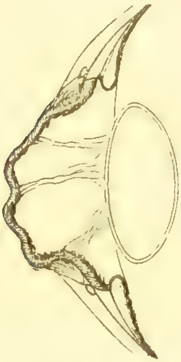

FIG. 30.

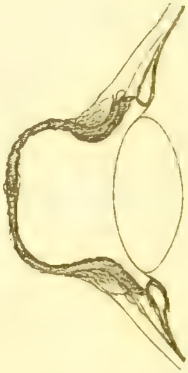

FIG. 31.

When prolapsus iridis has taken place, all the symptoms of the attending inflammation are apt to be aggravated. But if the inflammation subsides, and if the opening in the cornea and size of the prolapsed iris be within certain limits, the latter gradually contracts and flattens as the ulcer of the cornea closes, and nothing at last remains but the cicatrice in the cornea, and adhesion between this and the iris—*synechia anterior*—with more or less deformed and contracted pupil.

If in consequence of a more extensive destruction of the cornea, whether by ulceration or sloughing, the prolapsed portion of the iris have exceeded the limits alluded to, it never collapses, but, as will be by-and-by shown, lays the ground for the formation of a *staphyloma of the iris, partial or total.* Figure 31 represents total *prolapsus iridis*, the foundation for total staphyloma.

4th. *Iritis, or inflammation of the iris.*

In consequence of the coloration of the iris, it does not, like the conjunctiva, for example, when inflamed, appear red, but of a colour which is a compound of its own natural colour and that of the stagnant blood. Thus, as above mentioned (p. 26), a blue iris becomes green, a brown iris reddish-brown. The pupillary circle is, however, usually rather pinkish. The brilliancy of the iris is at the same time impaired or lost. Subsequent changes in the colour of the iris are owing to exuded matter and to changes in the pigment. (Plate III., fig. 1.)

The injected vessels of the iris are usually not very evident individually: sometimes, however, they are so, especially in parenchymatous inflammation.

The circumcorneal zone of sclerotic congestion is well marked. The conjunctiva may be little or very much injected—so much sometimes as to hide the sclerotic injection.

The aqueous humour is at first somewhat increased in quantity by serous effusion. Exudation of lymph afterwards takes place; and that either on the surfaces or into the substance of the iris. The exudation from the anterior surface and from the pupillary margin may be directly seen. Most commonly the exudation takes place first from the pupillary margin. On the anterior surface the lymph presents itself in drops, and fine flakes of it may often be seen in the aqueous humour, rendering it turbid.

The lymph exuded into the aqueous humour may be converted into pus or puriform matter, which, accumulating at the bottom of the anterior chamber, gives rise to *hypopyon*. Compare this diagram of the position of the matter in hypopyon with

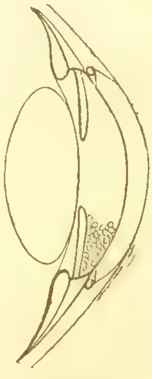

FIG. 32.

that at p. 115, representing the position of the matter in onyx.

The lymph exuded at the pupillary margin soon becomes consolidated and organized, forming bands of adhesion between the margin of the pupil and the capsule of the lens (*synechea posterior*)—distorting the pupil, and sometimes contracting it to a point.

The mode in which closure of the pupil takes place appears to be this; the pupil having been in a state of contraction when the lymph was exuded, the lymph, in consolidating, contracts and draws together more closely the margin of the pupil from which it has been exuded, and to which it is adherent.

New vessels may make their appearance in the lymph forming the bands of adhesion, in that exuded on the anterior surface of the iris, and also in that filling up the pupil.

The lymph poured out at the pupil, forming bands of adhesion, becomes of a brown or yellow colour from the deposition of pigment in it. Small red or brown masses of lymph are also sometimes seen on the outer circle of the iris, or at the margin of the pupil.

Though no distinct serous membrane can be demonstrated on the anterior surface of the iris, it thus, like the surface of inflamed organs, which are covered with serous membranes, pours out lymph, which gives rise to adhesions; but what is peculiar is, that the adhesion which takes place is generally between the iris and capsule of the lens, rarely, if ever, between the iris and the cornea, if the latter be unaffected with ulceration.

Parenchymatous inflammation of the iris may be looked upon merely as a more intense degree of inflammation, in which, to exudation on the surface of the iris, there is added exudation into its substance.

There is, in acute parenchymatous inflammation of the iris, greater vascular congestion both of the conjunctiva and sclerotica, together with congestion of the choroid, as may be inferred from the accompanying photopsy during life, and from its having been found on dissection after death that there was lymph on the inner surface of the choroid.

Exudation into the substance of the iris takes place principally at the pupillary circle, and is manifested by a rusty or tawny colour which that part of the iris presents.

Abscess is apt to form in such cases when acute. It appears as a small yellow tubercle on the surface of the iris, generally near its pupillary or ciliary edge, which bursting into the anterior chamber, gives rise to a small hypopyon. The place, where the abscess was, afterwards appears black, the iridal substance having become atrophied, so that the uvea shines through. When the abscess is quite at the ciliary margin, it may evacuate itself externally through the sclerotica, close to the place of its junction with the cornea.

Hæmorrhagic effusion also occurs in inflammation of the iris. The blood is usually in small quantity, forming a patch of greater or less size on the anterior surface of the iris, and tinging the exuded lymph. Sometimes an accumulation of blood appears at the bottom of the anterior chamber.

Healing process in inflammation of the iris.—As the congestion in iritis subsides, the progress of the absorption of the exuded matter is beautifully seen. Matter which has been recently exuded rapidly disappears. Tubercles of lymph with vessels ramifying on the surface progressively shrink, and the blood in the vessels becomes dark and dead-looking, like the blood in ecchymosis. Lymph, which has become organized into adhesions, having to undergo solution by a retrogressive metamorphosis, in order to be fitted for absorption, disappears slowly; and in many cases the organization is already so complete, that no process of removal takes place. Thickening and change of structure of the iris from exudation into its substance, together with contraction of the pupil and obstruction of it with lymph, are very often permanent.

Effused blood is in general readily absorbed, but after repeated effusions some remains unabsorbed, in the form of brown or black masses and patches, at the bottom of the anterior chamber and on the surface of the iris.

Inflammation of the lining membrane of the posterior chamber or uveitis.—Lymph may be exuded in large quantity into the posterior chamber, on the posterior surface of the iris, and on the anterior wall of the capsule of the lens. The source of this exudation is probably the vessels of the ciliary processes. See further on this head, infra, p. 124.

5th. *Inflammation of the ciliary body or circle (Kyklitis).*

The ciliary body not being accessible to direct observation, the anatomical characters of the early stages of inflammation affecting it can only be inferred.

The external redness of congestion, in the form of a sclerotic circumcorneal blush, it shares in common with the iritis that accompanies it. In a more advanced stage the redness becomes of a purplish tint, from the sclerotica now involved in the inflammation having become attenuated and dark coloured over the region of the ciliary body. (Plate III., fig. 2.)

In the chronic form, there is serous exudation, which, accumulating underneath the ciliary body, causes both it and the attenuated sclerotica to bulge out, forming anterior sclerotica staphyloma.

Towards the side next the projection the pupil may be displaced, owing to the iris being dragged by the portion of the ciliary body implicated in the staphyloma.

On the same side patches of opacity frequently form in the cornea. (Plate III., fig. 2.)

What has been above described as *inflammation of the lining membrane of the posterior chamber or uveitis* appears to be one form of inflammation of the ciliary body. The source of the lymph, which is exuded in large quantity into the posterior chamber, being the vessels of the ciliary processes.

6th. *Choroiditis and retinitis, or inflammation of the choroid and retina.*

The external redness of congestion, symptomatic of inflammation of the choroid and retina, cannot be seen, for, different from what is the case in regard to the structures hitherto considered, the bloodvessels of those under notice enter the eyeball at its back part.

By means of the ophthalmoscope, as above shown, pp. 48, 52, the retina and choroid may be directly observed during life, and much has now been made out concerning the anatomical characters of inflammation affecting them. The appearances above enumerated, viz., congestions, spots of extravasated blood, opacities of various appearance, pigment deposits, &c., are, some of them, the manifestations of inflammation in progress; others, the effects of past inflammation. In acute inflammation, of course, the eye could not bear examination.

The vessels of the choroid shine through the retina; but the mode of distribution of the vessels of the retina and choroid is so characteristic that inflammatory injection of the former can be readily distinguished from that of the latter independently of the difference of the seat and definition of the vessels.

Some of the opaque appearances which have been observed at the bottom of the eye are indications of exuded lymph deposited in the substance of the choroid,—or between the choroid and retina producing adhesion of the two membranes, with alteration of their textures including the pigment membrane of the one and stratum bacillosum of the other, and as has been repeatedly found on dissection. Others of the appearances again seem more distinctly referable to retinal exudation, extravasation, and pigment deposit.

The retina bulged forward and tremulous is an indication of serous exudation between the choroid and it on the one hand, and dissolution of the vitreous humour on the other. In such cases the retina has appeared sometimes, otherwise unchanged, sometimes degenerated in structure.

Ophthalmoscopic manifestations of inflammatory congestion of the choroid.—Increased redness of the fundus, either in patches or generally, behind the level of the retina, indicates congestion of red corpuscles in the capillary network on the inner surface of the choroid, and in the *vasa vorticosa* on the posterior.

Ophthalmoscopic manifestations of choroidal exudation.—In choroiditis, exudation may take place on the inner surface of the choroid, in the interstices of its stroma, and also between the choroid and sclerotica. If there should be such intense congestion as is presented by the conjunctiva in purulent ophthalmia, the exudation will be copious, and suppuration will take place, the result of which will be breaking up and disorganization of the whole interior of the eye. But before this, the other internal structures will have become implicated. The case will, thus, now be one of ophthalmitis, or ocular phlegmon.

The pigment membrane is detached and broken up by exudation from the chorio-capillary network.

Bluish-white deposits behind the retina indicate plastic exudation on or in the choroid. The exudation may be in the form of disseminated points, or in thin films, or in thick and prominent masses concealing the subjacent vascular structure.

Black or dark gray patches indicate pigment deposits in the stroma. Such may be seen scattered over the fundus, behind the level of the retinal vessels.

Usually around the plastic exudations, the congestion of the choroidal vessels is intense, and the pigment deposits well marked.

Ophthalmoscopic manifestation of extravasation of blood.—Patches of extravasated blood appear dark red in the centre and clear at the edges, lying behind the level of the retinal vessels. After a time they are found to have become yellowish or light brown, and surrounded by pigment deposits.

Manifestation of atrophy of the choroid.—A result of chronic choroiditis and of extravasations of blood is atrophy of the choroid at the affected spots. Through the atrophied choroid, the sclerotica appears in the form of white or yellowish-white patches, adjacent to which are pigment deposits. The patches of sclerotica denuded of the choroid being still covered by the retina, the vessels of the latter are seen ramifying over them. Atrophy of the choroid adjacent to the papilla optica in posterior sclerotic staphyloma is an example of this change which we have had occasion to notice above at p. 60.

The bluish-white patches of choroidal exudation are to be distinguished from these white sclerotic patches.

It is to be remembered that the different states, just described, are not met with singly or unaccompanied by each other, or by analogous degenerations of the retina, the vitreous and even the crystalline body. For inflammation does not long remain confined to the choroid. The retina in particular soon participates.

Ophthalmoscopic manifestation of inflammatory congestion of the optic papilla and retina.—The papilla is red from the injection of small vessels seen on its surface. It may be red all over, or only to the extent of one half or less. In general congestion of the papilla and retina, the whole fundus is reddish-gray and dull-looking, whilst the papilla is scarcely distinguishable from the retinal surface, except by the emergence of the large central vessels. Of these vessels, the arteries are constricted and the veins turgid.

Ophthalmoscopic manifestation of exudation.—Whitish patches here and there on the surface of the retina on a level with or in front of the vessels—sometimes like a film half concealing them—sometimes more decidedly opaque. These patches may be seated around the papilla, covering more or less of it,—or they may be seated rather towards the *ora serrata*;—frequently, they occur in the form of a whitish track in the course of the central vessels.

In retinal exudations, the central vessels implicated may be buried in the opaque patches, and only reappear further on in their course, whereas in choroidal exudations, the retinal vessels appear in front of the patches.

Healing process in inflammation of the retina.—It is obvious that, in this case, anything entitled to the name of a cure can take place only if the congestion and exudation be stopped before the delicate structure of the retina has been affected thereby. Such a favourable termination does sometimes take place.

Ophthalmoscopic manifestation of extravasation of blood.—The extravasation may be diffuse or circumscribed. In the latter case the spots, irregular in shape, present themselves at various points of the fundus—frequently in the course of the central vessels beyond the papilla—sometimes the papilla is the seat of an extravasated spot.

After a time the spots of extravasation assume a reddish-brown colour at the circumference, and may become surrounded with a whitish border from exudation.

Ophthalmoscopic manifestation of pigmentous degeneration of the retina.—Chiefly towards the *ora serrata*, but, it may be, over the whole retina, black spots are seen scattered. Some of these pigment deposits occupy the track of the vessels,—some are situated at the bifurcations of the vessels,—and some lie over and conceal the vessels, which may, however, be otherwise unaltered thereby. Subsequently, however, the vessels are found some shrunk, some actually obliterated.

In extreme cases, the papilla is observed to be atrophic, excavated, and of a dull white appearance.

7th. *Neuritis optici or inflammation of the optic nerve.*

In tumours, exudations, or exostoses at the base of the cranium or within the orbit involving the optic nerve, the following appearances presented by the fundus of the eye under the ophthalmoscope give evidence of the inflammation of which the optic nerve is the seat :—

Reddish-gray opacity and swelling of the papilla with ill-defined contour. In consequence of the opacity, the central vessels, at their emergence, cannot, as usual, be followed by the eye back to the lamina cribrosa. On the retina, the arteries are constricted and the veins turgid, with various degrees of extravasation of blood in their course.

As a result of the inflammation, the papilla is seen at a subsequent period to have become white and atrophic.

Reddish-gray opacity and swelling of the papilla, like what has been above described, occurs in Bright's disease —sometimes alone,—sometimes as the precursor of the characteristic degeneration of the retina (sclerosis of the nerve fibres and fatty degeneration of the connective elements),—sometimes only after the most extensive retinal degeneration has long existed.

8th. *Inflammation of the lenses of the eye.*

These bodies being, like the cornea, non-vascular in the fully developed state, inflammation of them consists at first merely in exudation into or on them ; the vascular congestion having its seat in adjacent parts.

Inflammation of the aqueous humour.—In those cases in which we have above seen the aqueous humour to be the seat of inflammatory products, it may, in a sense, be said to be inflamed. And when these products become absorbed, healing may be said to take place.

Regeneration of the aqueous humour.—When the aqueous humour has been evacuated, regeneration of it takes place within twenty-four hours. The blood circulating in the ciliary processes appears to be the source whence the new aqueous humour is derived.

Inflammation of the crystalline body.—Inflammation of the crystalline body is first evidenced by opacity of the capsule, resulting from exudation into or on it. In the exuded matter new vessels may be developed. But where is the seat of the primary congestion ? This appears to be different according as it is the anterior or the posterior wall of the capsule which is affected.

In uveitis, p. 123, the anterior wall of the capsule has often exuded matter deposited on it, in which new vessels are sometimes developed. This is the kind of case described as inflammation of the anterior wall of the capsule.

Whilst inflammation of the anterior wall of the capsule belongs to the head of inflammation of the anterior segment of the eye, what has been viewed as inflammation of the posterior wall of the capsule comes under the head of inflammation of the posterior segment.

When the capsule of the lens is affected, as above described, the lens itself becomes more or less altered in consequence,—opaque, dissolved, or even the seat of suppuration.

Healing process in the crystalline body.—Wounds of the crystalline body are, in the human eye, followed by opacity, and the lens, by being exposed to the aqueous humour, is eventually dissolved and absorbed. As to the capsule it is very apt to become opaque, but is never absorbed like the lens. If small, a wound of the capsule may heal, in which case the lens, though it may have become opaque, will not be absorbed.

Regeneration of the lens.—Indications of a regeneration of lenticular substance have been described. But though interesting in a pathological point of view, the question is one of no practical importance, as nothing in the shape of a new lens is restored.

Inflammation of the vitreous body.—The inflammatory changes of the vitreous body, such as deep-seated extravasations of blood, deposits of lymph, or collections of matter, appear principally to depend on congestion of the vessels of the retina or ciliary zone. From Donders and Van Trigt's observations by means of the ophthalmoscope, however, it would appear that affection of the vitreous body is sometimes independent of, at other times proceeds *pari passu* with, affection of the retina and choroid. On the other hand, the retina and choroid may have undergone change of structure from chronic inflammation without any opacity of the vitreous having taken place.

Healing process in the vitreous body.—Healing of the exposed cut surface of the vitreous by granulation and cicatrization is well observed after the operation of abscission of fully formed total spherical staphyloma. The wound becomes covered with granulations proceeding from the cut edges of the sclerotica. These granulations are condensed into semi-transparent membrane, which by-and-by becomes opaque, contracts and draws together the edges of the sclerotica and conjunctiva, forming a linear or stellate cicatrice.

Atrophy of the vitreous body.—Under this name may be designated that state in which, with softening of the eyeball, the hyaloid membrane is resolved into shreds, and the vitreous body thus reduced to the state of a viscid fluid (*synchysis*). Under the ophthalmoscope, membraneous shreds and filaments are sometimes seen suspended in the fluid.

Regeneration of vitreous humour.—When in consequence of atrophy of the hyaloid, some of the vitreous humour escapes in the operation of extraction, &c., if the quantity be within certain limits the loss may be made good, but if beyond those limits, the loss is not made good, and the eyeball collapses.

B. SUBJECTIVE PHENOMENA.

In entering on this part of the subject, it is, in the first place, necessary to distinguish between the morbid sensations depending on perversion of common sensibility and those depending on perversion of special sensibility.

1st. *Morbid sensations depending on perversion of common sensibility, accompanying inflammation of the different tissues.*

Conjunctiva.—Like other mucous membranes close to the natural apertures of the body, the conjunctiva is endowed with a high degree of common sensibility; but being loose in texture, the pain which attends inflammation of it is not very severe. There is, however, considerable heat.

The most characteristic pain is like that produced by a foreign body in the eye—a sensation which attends inflammation of other mucous membranes near the surface of the body. The sensation as if a foreign body were in the eye is owing to enlargement of the vessels on the one hand, and to increased sensibility of the conjunctiva on the other.

Attendant on inflammation of the conjunctiva, there are also itchiness and smarting at the edges of the eyelids, with occasional stitches of pain shooting from them.

Sclerotica.—Very severe pain of a rheumatic character around the orbit, in the temples, &c., is a characteristic of sclerotic inflammation or congestion, owing either to accompanying congestion in the parts mentioned, or to nervous irradiation.

Cornea.—The sensation in the cornea itself is one of pressure. But as inflammation of the cornea is attended with injection of the conjunctiva and sclerotica, there may be also the sensation of a foreign body in the eye peculiar to the former, and the rheumatic pain peculiar to the latter. Great intolerance of light is a common accompaniment of acute inflammations of the cornea.

Iris.—When the iris is inflamed, there is necessarily more or less sclerotic congestion, hence the sclerotic rheumatic pain which so often accompanies iritis. There is usually also some implication of the cornea; hence the intolerance of light. As to the pain within the eyeball itself, it may be accounted for as much perhaps by the distension to which the exterior tunics are subjected by the increased accumulation of blood and fluids in the interior of the eye, as by supposing it to be seated in the iris itself.

Choroid.—The ciliary nerves lying on the exterior surface of the choroid, cannot fail being implicated in inflammation of it. The choroid itself does not appear to be endowed with any sensibility. Pain, when it attends choroiditis, is chiefly owing to the distension of the eyeball, and to attending congestion of other parts.

Retina.—The morbid sensations depending on perversion of common sensibility, which may attend inflammation of the retina, have not their seat in the retina, but are merely owing to distension of the eyeball, and accompanying congestion of other parts.

2nd. *Morbid sensations depending on perversion of the special sensibility of the retina.*

When nervous structures endowed with special sensation are irritated, the sensation produced is not pain, but various modifications of the sensation peculiar to the structure, and this whatever be the irritating agent. Thus, when the retina is in a morbidly sensible state, irritation of it by light gives rise to a dazzling glare, which is so distressing that the patient seeks to protect the eye against light; this constitutes intolerance of light, or photophobia. But even in the dark the same dazzling glare, or various kinds of luminous spectra, may be produced by pressure, &c., and that in a degree more or less distressing, according to the morbid sensibility of the retina, and the intensity of the pressure or other irritating cause: this constitutes photopsy.

The appearance of a gauze or mist, or "a skin with veins in it," appears to be the proper subjective effect of the congestion and exudation in inflammation of the retina.

The other special morbid sensations, photopsy, a morbid sensibility to common impressions, and photophoby, occur rather as accompaniments of inflammation of other structures of the eye than of the retina itself. Thus the morbid sensibility of the retina on which intolerance of light depends, is an accompaniment of those acute inflammations in which the cornea is especially involved. Luminous spectra again appear to be occasioned in inflammation of the choroid, principally by the pressure on the stratum bacillosum of the retina, arising from the congestion and exudation. This is illustrated by the effect of pressure with the point of the finger on the exterior of the eyeball. See "*Phosphènes*," p. 73.

§ II. COMPARATIVE SURVEY OF THE MODIFICATIONS OF THE PHENOMENA OF INFLAMMATION ACCORDING TO THE STRUCTURE AFFECTED.

The phenomena of inflammation, and its events, having thus been abstractedly considered, as they occur in the different textures of the eye, a comparative survey may now be taken of the modifications which those phenomena present, according to the structure affected.

Objective phenomena.—The more vascular conjunctiva, when inflamed, is redder than the less vascular sclerotica; and the non-vascular cornea is not red at all, but the congestion, and consequently the redness attending inflammation of it, are seated in adjacent parts. Redness of the cornea itself, however, may be subsequently superadded by the development of new vessels in it (Plate I., fig. 3). Lastly, in the coloured iris, the congestion is not manifested by redness, but by a colour a compound of the yellowish-redness of a thin stratum of blood, and the natural colour of the inflamed structure (Plate III., fig. 1).

Exudation takes place more copiously from the conjunctiva and iris than from the less vascular sclerotica, and *cæteris paribus*, the exudation is in proportion to the degree of inflammatory congestion. The exuded matter is for the most part poured out from the surfaces of the conjunctiva and iris, and there is little swelling and thickening, manifesting interstitial exudation, in comparison with the whole quantity of matter exuded; whereas in parenchymatous structures, the exuded matter being received into their interstices, exudation is manifested by more or less considerable swelling. Exudation may give rise to phlyctenulæ and pustules on the surface of the cornea,—to abrasion on that of the conjunctiva ; a difference which is owing to the difference in the resistance of the epithelium investing the two surfaces. Exudation may take place into the cellular tissue underneath the conjunctiva in inflammation of that membrane, in which case the swelling, called *chemosis*, arises. Lastly, in congestion of the sclerotica, there is comparatively little disposition to exudation, and when it does take place, it is often rather into the neighbouring cornea than into the substance of the sclerotica itself—a peculiarity which seems to hold in the case of other fibrous structures, for example, those around joints in rheumatic gout.

From the surface of the conjunctiva, when it is the seat of intense inflammatory congestion, slight hæmorrhage readily occurs; but in less intense inflammation, extravasation of blood occurs in the form of patches of ecchymosis into the loose cellular tissue underneath the sclerotic conjunctiva. Effusion of blood may take place from the surface of the inflamed iris, analogous to the hæmorrhagic exudations of inflamed serous membranes—and extravasation may also occur into its substance. But in the latter case, as also in that of extravasation into the substance of the cornea, the spots of ecchymosis are small in comparison with those which present themselves in the loose subconjunctival tissue. The readiness with which bleeding takes place from the surface of the conjunctiva, when the seat of intense congestion, is explicable by the exposure to foreign contact of its delicate superficial capillary network in a state of great distension.

A modification of the phenomena of the events of inflammation might *à priori* be presumed to occur in different structures, in consequence of that physiological difference which determines the mode of assimilation peculiar to each structure. That such a modification holds to a certain extent only, and is readily broken through by modifying influences, is shown by the formation of pus in very different structures, and by the circumstance that a kind of cellular tissue and blood vessels are the new structures most commonly regenerated, whatever the original structure may be.

An influence which manifestly modifies the manner in which the exuded matter is disposed of, consists in the exposure or non-exposure of it to the contact of foreign bodies, including the external air. The matter exuded on the surface of the conjunctiva in contact with the external air, tends to be converted into pus or puriform matter, whilst that exuded on the surface of the iris out of contact with air, is more disposed to be converted into tissue, forming bands of adhesion.

The mode in which exposure to the contact of foreign bodies operates in determining suppuration, is probably by their irritation keeping up the congestion, and thus causing exudation in large quantity and of a certain quality. In the cases in which the exuded matter is converted into pus, though not in contact with foreign bodies, the exuded matter has been deposited in large quantity, in consequence of the greatness of the congestion from other causes.

In the cornea, there may be observed what will perhaps be admitted as an exemplification of the influence of comparative quantity of exuded matter, in the disposal of it. When exudation takes place slowly and in small quantity, it is developed into tissues; but when exudation takes place rapidly and in large quantity, suppuration results.

The disposition of the iris to form adhesions with the capsule of the lens, as in the case of serous surfaces, presents a remarkable contrast to the indisposition, which, in common with other mucous surfaces, those of the inflamed conjunctiva have to adhere, even when in close apposition, except when abraded, and therefore no longer mucous surfaces. This appears to point to some peculiarity in the matter, considered as a blastema, exuded from mucous surfaces. Sometimes, indeed, the matter exuded on mucous surfaces presents itself in the form of pseudo-membranes; these, however, do not become organized, like the pseudo-membranes of serous surfaces, but are eventually separated and thrown off like dead parts.

In regard to the formation of adhesions between the iris and capsule of the lens (*synechia posterior*), it has been contended, that the condition for their formation is not exudation of plastic lymph from an inflamed iris alone, but that the capsule, as well as the iris, must be in a state of inflammation at the same time.

However this may be as regards serous membranes generally, it is to be observed of the case under notice, that since inflammation of the anterior wall of the capsule of the lens consists at first merely in exudation into or on it, the exuded matter having its source in congestion of neighbouring parts, there can scarcely be any difference whether the lymph is exuded from the pupillary margin of the iris, or from the same source as in those cases which are considered to come properly under the head of anterior capsulitis (p. 128-9). It must be admitted, that synechia posterior occurs in cases in which it would be rather too much to say, that in addition to the iritis, there was anterior capsulitis also.

On the other hand, there is great indisposition to the formation of synechia anterior, even when the corresponding surfaces of both iris and cornea are inflamed and in contact, except when there is abrasion of the corneal surface.

Of the different structures of the eye, the cornea is that most prone to mortification and ulceration.

Subjective phenomena.—The most striking modification of these, perhaps, is the difference of pain. Thus the pain which attends inflammation of the conjunctiva is like that produced by a foreign body in the eye, whilst the pain in inflammatory congestion of the sclerotica is of a rheumatic character, and seated around the orbit, in the temples, &c. Dimness of vision attends inflammation of the retina. The various morbid visual sensations are the result of the pressure, irritation, &c., to which the stratum bacillosum of the retina is subjected in inflammation of other structures of the eye.

§ III. CAUSES OF OPHTHALMIC INFLAMMATION.

The practical advantage of being acquainted with the causes of ophthalmic inflammation is to know how to avoid them, and thus to prevent the inflammation; or, if they have already produced inflammation, to know how to remove them if still in operation and removable.

The causes of ophthalmic inflammation may be referred to three heads,—viz.—1st. Those which operate directly on the eyes. 2nd. Diseases of other parts with which the eyes sympathize, or which spread to the eyes. 3rd. States of constitution and constitutional diseases which, though they do not necessarily determine inflammation of the eyes, at least predispose them to be affected by other causes, and modify inflammations thereby excited.

To the first head belong:—direct injuries—direct influence of cold—the direct action of very strong light, or of this and strong heat together—the irritation of reflected light—over-exertion of the sight, especially in bad light, either too weak or too strong, with much stooping of the head—the direct influence of acrid vapours,—epidemic or endemic influences—the direct application of contagious matters. These are all exciting causes, but some of them require to be assisted by other causes, so that they operate partly as predisposing causes also.*

To the second head belong diseases of the skin, especially the exanthematous diseases.

To the third head belong the scrofulous, rheumatic, or gouty diathesis, and constitutional syphilis.

Under the influence of these causes, different forms of ophthalmic inflammation are produced.

The influence of the exciting cause in modifying inflammation, appears to consist, sometimes in merely determining inflammation in a particular tissue, as when exposure to cold causes a catarrhal ophthalmia; sometimes, also, in the circumstance, that the exciting cause exerts a specific action, as in the case of the primary operation of the syphilitic or variolus poison.

The influence of the state of the constitution or of constitutional disease, appears to consist in modifying the action of the exciting cause, as regards its effect in determining inflammation in a particular tissue, at the same time that it may impart peculiar characters to the inflammation,—thus, in particular states of constitution, exposure to cold will determine phlyctenular rather than simple catarrhal ophthalmia: or in a constitution tainted with syphilis, for example, it will determine parenchymatous corneitis or iritis rather than any other form of ophthalmic inflammation.

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* When the eyes are much exposed to irritating vapours, inflammation, usually of the conjunctiva, is excited and kept up. In like manner, the nitrate of silver ointment, nitrate of silver in substance, bluestone, and the like, when too frequently repeated, aggravate the ophthalmia, against which they are used, and render it obstinately chronic. In such cases, we find the conjunctiva thickened, cuticular, and shrunk. The contraction, telling very much upon the looseness of the folds of the conjunctiva at the upper and lower palpebral sinuses, great restriction in the movements of the eyeball at the same time results.

It would, however, be endless, if not impossible, to trace the innumerable combinations of influences modifying inflammation.

§ IV. TREATMENT OF OPHTHALMIC INFLAMMATION.

In consequence of the peculiarity of the structure and functions of the eye, its usefulness is apt to be interfered with by such effects of inflammation as in most other organs would be of little or no moment. Hence, though the treatment of ophthalmic inflammation must be conducted on the same general principles as that of inflammation of any other part of the body, it is necessary, *cæteris paribus*, to push it with more activity, and at the same time to attend to numerous special details. Thus, in iritis, bloodletting and mercurialization require to be pushed to a greater extent than might in another organ be thought advisable for the same kind and degree of inflammation. But supposing bloodletting and mercurialization thus pushed have been successful in subduing the inflammation, the neglect of such details as the application of belladonna to keep the pupil dilated, may have allowed it to become closed, or the lens spotted over with depositions of lymph, in which case vision will be lost or greatly impaired.

In the treatment of ophthalmic inflammation, the first points to be attended to (besides, as a matter of course, the removal of the exciting cause, if still in operation and removable), are the protection of the eyes from everything which can cause or keep up irritation—such as using them or exposing them to strong light—and the avoidance of whatever is calculated to operate injuriously on the system in general, such as exposure to the weather, corporeal exertions, errors of diet, &c.

When ophthalmic inflammation is sympathetically connected with disease of some other organ, as the exanthematous ophthalmiæ are with the inflammation of the skin, or symptomatically connected with some general diathesis, as scrofula, or disease, as syphilis, the treatment of the ophthalmic inflammation ought not to be delayed until the removal of the disease with which it is sympathetic, or of which it is symptomatic.

It is true that the local disease cannot always be cured or alleviated until the removal of the general disease, and that the removal of the general disease will, of itself, often determine the subsidence of the local. This, however, ought not to prevent us from at least attempting to relieve the eyes as quickly as possible.

For the cure of ophthalmic inflammation, as for that of inflammation generally, different plans of treatment are required according to the structure or structures affected, the degree and stage of the inflammation, &c.

The treatment of ophthalmic inflammation is divided into general and local, of each of which there are two principal plans. The two principal plans of general treatment are — the antiphlogistic, properly so called, including mercurialization,—and the tonic and alterative. These two plans may be variously modified and combined, according to the circumstances of the case. The two principal plans of local treatment are—the antiphlogistic and soothing,—and the irritating or stimulant. These, again, may be variously modified or even alternately employed according to the circumstances of the case.

1st. *General.—Antiphlogistic treatment.*

General bleeding.—This is not now often had recourse to. It is, however, sometimes required in acute ophthalmia, whether external or internal, but especially the latter. Incompressibility of pulse, hot skin, and white tongue, are the general indications of the propriety of bleeding. The objective and subjective states of the eye will often of themselves furnish indications, irrespective of those just mentioned. Circumorbital pain, for example, is a good indication; for when an ophthalmia is attended by it, venesection in general soon gives relief and promotes the operation of other remedies.

It is to be remarked that when circumorbital pain is severe, and has already continued some time, there may be a state of depression. This, however, ought not to forbid the abstraction of blood in the case of an otherwise strong person; on the contrary, venesection, by relieving the pain, removes the state of apparent depression.

The quantity of blood abstracted must depend on the nature of the inflammation and the strength of the patient —from ten to twenty ounces may in general be safely taken. Nor need a repetition of the abstraction of the same quantity be dreaded. In severe inflammation, the system in general tolerates a greater abstraction of blood, as it does larger doses of tartar emetic, &c. Arteriotomy does not appear to have any advantage over venesection.

Cupping, a sort of mean between venesection and leeches, may sometimes be employed to supersede venesection; but, in general, cupping is more applicable in chronic internal ophthalmia—cases in which the tonic and lterative plan of treatment is indicated.

In acute internal inflammation, by trusting to cupping, he system may be drained of blood without any advantage to the eye; but, on the contrary, the cure will be protracted, and the organ left weak, relaxed, and for a ong time liable to become congested from the slightest cause.

Mercurialization.—In the internal ophthalmiæ, mercury s an indispensable remedy. In acute iritis, for example, when the system is brought under the influence of mercury, he inflammation is in general observed to abate, and as his abatement goes on, the effused lymph becomes aborbed. The operation of the mercury is promoted by ombination with opium.

The action of mercury is commonly described as simply orbefacient; but it appears to be sorbefacient merely ecause it subdues the inflammation, which has caused he exudation or the congestion which prevents the aborption.

Iodide of potassium has been recommended as a remedy n iritis; mainly under the idea that the absorption of ymph already begun under the influence of mercury will e continued and promoted by it. The contrary of this, have, however, found to be the case. The effect of the odide is to remove the mercury from the system, and thus low the exuded lymph to become consolidated and fixed the pupil, from which it does not afterwards admit of eing readily absorbed.

Turpentine has been employed with considerable success iritis and some forms of corneitis, but it is not so certain remedy as mercury. Combined with cod-liver oil, I ave found it very beneficial in parenchymatous corneitis d in iritis.

Tartar emetic.—The antiphlogistic powers of tartar emetic are not, perhaps, so strikingly displayed in ophthalmic as in pulmonary inflammation; considerable advantage is, however, often obtained from it. The treatment of the phlyctenular ophthalmia of children, for example, is often very materially assisted by tartar emetic, first in emetic, and afterwards in nauseating doses.

Purgatives.—As regards the use of purgatives in ophthalmic inflammation, it is to be observed, that it is sometimes only after a free action on the bowels that a decided abatement of the inflammation takes place.

Diaphoretics.—Dover's powder or James's powder forms a valuable addition to calomel in the treatment of anterior internal ophthalmia.

Nitre is a favourite remedy in inflammation, generally. It has been highly recommended in ophthalmic inflammation, sometimes, even, in preference to mercury and tartar emetic: not affecting the gums like the former, nor causing vomiting like the latter. It is, however, not to be trusted to as a principal means of cure.

Colchicum.—Colchicum, mercury, and Dover's powder form a combination from which much benefit is obtained in rheumatic and arthritic inflammations.

Chloroform.—In cases of parenchymatous corneitis and scrofulous ophthalmia, great relief to the intolerance of light is obtained from subjecting the patient to the influence of chloroform, every second day for a few times. The cure is at the same time promoted.

Opium.—In internal inflammations attended by severe pain, in which opium in the ordinary doses (with calomel) has been given without relief, larger doses of opium (one or two grains) often prove beneficial by subduing the excessive irritability. Opium by itself, however, is not so efficacious as in combination with calomel.

Belladonna.—This is a most important medicine in the treatment of ophthalmic inflammation. Externally, it is employed to keep the iris contracted in iritis, and thus to oppose the tendency to closure of the pupil, and thereby to prevent depositions of lymph on the middle part of the anterior capsule, and synechia posterior. Against intolerance of light, and especially that which is so distressing a symptom in phlyctenular ophthalmia, it sometimes acts like a charm.

Internally, it is given as an anodyne to relieve neuralgic pains about the eye, and even the pain attendant on internal ophthalmia, which it sometimes does relieve in a very striking manner.

But besides these effects, belladonna appears to exert an influence in subduing the inflammation itself.

The different forms in which belladonna is employed for external application are given above at pp. 80, 83.

When we prescribe belladonna internally, it is usually either in the form of the powdered leaves or in that of the tincture. The powdered leaves in grain doses to children, and the tincture in doses of ♏x-xx to grown up persons.

The great therapeutic value of belladonna in ophthalmic practice, as well as its dangerous effects in an overdose, render it worth while here to direct particular attention to its mode of action on the system.

In the course of my researches on the state of the blood and the blood vessels in inflammation, I ound that the application to the rog's web of a solution of the ulphate of atropia (four grains o the ounce of water), was fol-owed by constriction of the ar-eries of the part in about the ame time that the dilatation of he pupil supervenes on the drop-ing into the eye of the same olution.

The annexed figure represents n artery of the web of a frog hus constricted by the action f the sulphate of atropia. The pplication of a stronger solu-ion of atropia was followed by still greater degree of con-triction of the arteries. And he effect of this constriction of he arteries on the flow of blood n the web was partial conges-on of red corpuscles in the ca-illaries and venous radicles.

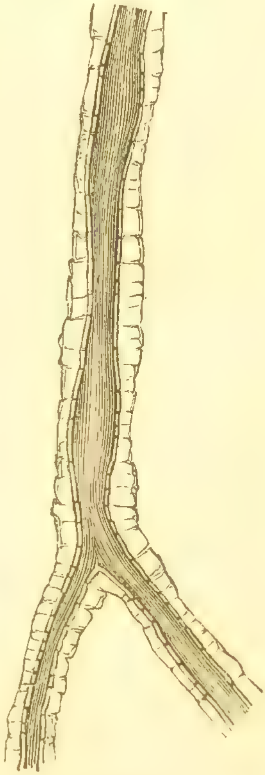

FIG. 33.

As the constriction of arteries owing to contraction of the rcular fibres composing their uscular coat, it follows that he *modus operandi* of the atropia in this case must be to excite the contraction of those fibres.

In first recording the observation, which I have now mentioned, in my essay "On the State of the Blood and the Blood-vessels in Inflammation," published in 1850, I identified the action of atropia in exciting contraction of the circular fibres of the muscular coat of the arteries with its action in causing dilatation of the pupil; which action I considered to be by exciting contraction of the radiating fibres of the iris,—a view which I had previously enunciated in the first edition of the present work, which appeared in the beginning of the year 1847, to the effect that, considering the state of relaxation of the iris is that in which the pupil is neither much contracted nor much dilated, as I had many years before insisted on, and that contraction and dilatation of the pupil are manifestations of an active state, the former of the circular, the latter of the radiating fibres of the iris, it is to be inferred that the action of belladonna in producing dilatation of the pupil consists in calling forth, through the medium of the ganglionic system, the contraction of the radiating fibres. These fibres, it was remarked, differ from the circular fibres, being immediately under the influence of the ganglionic system.

The passage now quoted was, in the first edition, followed by a conjecture that the action of belladonna on the arteries consists in determining contraction of their walls, they being like the radiating fibres of the iris under the influence of the ganglionic sytem. In thus expressing myself, I had in view the fact, long before known, that section of the sympathetic in the neck is followed by contraction of the pupil, and vascular injection of the eye.

In the second edition, *i.e.*, after I had made the observation that atropia does actually excite constriction of the small arteries, the same passage occurs, and is succeeded by the remark that the action of belladonna in dilating the pupil by exciting contraction of the radiating fibres of the iris, is analogous to that which I had found it to possess of determining constriction of the small arteries of the frog's web.

Leaving for the present the consideration of the action of belladonna on the pupil, let us endeavour to trace its constricting action on the small arteries, as visible under the microscope, in those more palpable phenomena which are evidences of its operation on the system, and which have been comprised under the name of *atropism.* To take first, the effects of atropia solution dropped into the eye:

Congestion of the conjunctiva is sometimes induced, but when the use of the atropia is discontinued, the conjunctiva recovers its natural paleness. Taught by my microscopical observation of the action of atropia applied to the frog's web in causing constriction of the small arteries and consequent congestion of red corpuscles, in the corresponding capillaries and venous radicles, I view the redness of the conjunctiva in such a case as the effect of constriction of its small arteries induced by the contraction of their circular muscular coat excited by the action of the atropia.

Seeing that constriction of the small arteries of a part causes congestion of the capillaries and venous radicles to which they lead, and seeing that the fundamental morbid condition of the eye in glaucoma is great venous congestion with constriction of the small arteries, we can understand how it is that belladonna or atropia applied to the eye in glaucoma aggravates the symptoms by increasing the constriction of the small arteries of the choroid and retina, and so determining an augmentation of the congestion in the veins.

When the glaucomatous state is not much developed, he eye slowly recovers from the injurious operation of he belladonna. This may not, however, prove to be the case in an advanced stage of the disease. In a stage in which the sight is already much deteriorated, a single application of belladonna to the eye is likely to deteriorate it still more, and that irrecoverably, to the great horror and distress of the patient and his friends, and to he discredit of the doctor.

In cases in which belladonna has been taken in poison-us doses, we find very striking marks of constriction of he arteries. For example, the small pulse, the dryness f the mouth and throat, the paleness succeeded by the ushing of the face, the blue injection of the conjunctiva, he coldness and cold sweats.

The small pulse speaks for itself. The dryness of the mouth and throat, which is commonly so early a symptom, no doubt arises from the constriction of the rteries of the mucous membrane of the fauces, and consequent suppression of its secretion. Atropia dropped into the eye, is sometimes followed by a dryness of the throat from its having passed thither by the lacrymal passages.

The paleness of the face arises from the impeded access of blood by the constricted arteries; but gradually red corpuscles accumulating in the capillaries and venous radicles, in consequence of the diminished *vis a tergo*, the paleness is succeeded by the flushing of the face.

The blue injection of the conjunctiva is due to the same cause—venous congestion—as I have just explained.

The coldness and cold sweats are owing to the determination of the blood from the surface, and general venous congestion.

To the venous congestion of the brain and spinal marrow, dependent on the constriction of the arteries, may be ascribed the cerebral symptoms, the diminution or loss of muscular power, &c.

Whilst in the course of my researches on the state of the blood and the blood-vessels in inflammation, I found that the application to the frog's web of a solution of the sulphate of atropia was followed by constriction of the arteries of the part and stagnation of blood in the corresponding capillaries and venous radicles, I found that the application to the frog's web of certain other agents produced a contrary effect, viz., dilatation of the arteries and a brisker flow of blood, and the dissipation of any congestion which may have existed at the time. The agents referred to are what are commonly called irritants or stimulants. Those which I principally used in my experiments were a solution of sulphate of copper (gr. xvj.—℥j.) with vinum opii (℥i);—or vinum opii alone,—or Battley's liquor opii,—or spirit of wine.

The primary effect of these and such like irritating or stimulating applications was constriction of the arteries, but that was only momentary, being quickly followed by dilatation. Often the dilatation was unpreceded by any constriction.

As constriction of arteries is owing to contraction of the circular fibres composing their muscular coat, dilatation of arteries must necessarily be owing to relaxation of the same fibres. It follows that the *modus operandi* of the agents I have mentioned must be, so far, the contrary of that of belladonna.

This I found by direct experiment and microscopical observation to be the case; thus:—

An artery of the frog's web was noted, under the microscope, to be varicosely constricted, almost to obliteration, after the application of atropia to the web. The blood was no more than flowing in the vessel, when I applied Battley's liquor opii. The effect was full dilatation of the artery, and brisk flow of blood. In another case, sulphate of atropia solution having decidedly determined constriction of the arteries and partial stagnation, the sulphate of copper solution, with vinum opii, was applied, and caused dilatation of the arteries, with briskness of the flow of blood, but not to so great a degree as in cases where no atropia has been previously used.

On the other hand, I have remarked that arteries which have been caused to dilate by the application of Battley's liquor opii, or the solution of the sulphate of copper with vinum opii to the web, may be made to contract again by washing away those substances, and applying atropia instead.

Having shown by microscopical observation and experiment, that the action on the arteries of certain substances commonly called stimulants, is so far antagonistic to that of belladonna, and having attributed to that action the dissipation of congestion of the conjunctiva, whether induced by the action of belladonna or by the action of cold as in catarrh, let us now ask, what are the agents which have been found to operate as antidotes to the poisonous effects of belladonna?

The answer is, stimulants, diffusible stimulants such as ammonia, brandy, &c., the very agents which, when duly applied, cause dilatation of the arteries, and a free circulation of blood.

Although belladonna has the effect of inducing constriction of the arteries and consequent congestion, it appears to exert an influence in relieving inflammation of a certain kind. For example; the irritable inflammation of the erethitic form of scrofulous ophthalmia, in which he visible vascular injection is in small proportion to the functional disturbance.

This brings me to consider that kind of inflammation of the eye induced by section of the sympathetic in the neck.

The occurrence of inflammatory congestion of the eye after section of the sympathetic in the neck, which had been previously long known, I attributed (in the first edition of the present work), to paralysis of the walls of the blood-vessels of the eye; and in my essay on the state of the blood and the blood-vessels in inflammation, published in 1850, an effect of section of the ischiatic nerve in the frog is stated to be dilatation of the arteries, and a fuller and more rapid circulation of the blood in the web. Pp. 12-20, 31-39.

To give an example:—The ischiatic nerve of the left leg of a frog being divided, the arteries of the web were found on examination dilated, and the stream of blood in them fuller and more rapid. The blood in the capillaries and veins especially appeared to be unusually loaded with red corpuscles. The general effect to the naked eye was increased redness of the web.

In 1852, in repeating the old experiment of cutting the sympathetic nerve in the neck of a cat or rabbit, M. Bernard, of Paris, discovered, in addition to the effects previously observed, that there supervened increased redness and heat of the ear and side of the head.

It had been shown in 1846 by Dr. Biffi that when the pupil had become contracted after section of the sympathetic in the neck, irritation of the nerve above the section excited dilatation of the pupil.

In like manner it occurred to Dr. Brown-Séquard, that irritation of the sympathetic would cause constriction of the blood-vessels of the head, which had become dilated, as discovered by Dr. Bernard, in consequence of section of the sympathetic. Accordingly, on performing the experiment of galvanizing the sympathetic in the neck above the section, Dr. Brown-Séquard found the increased redness and heat were for the time diminished, in consequence of the contraction of the vessels which are under the influence of the sympathetic.

From my previous observations and experiments I inferred that the vessels especially acted on in these cases are the arteries, for the walls of the capillaries are not contractile, nor are the walls of the veins materially so, except in the bat's wing, in which *I have discovered they possess the extraordinary endowment of rhythmical contractility, like the heart* *.

In the cases of ophthalmia I have referred to, in which belladonna so often operates beneficially in relieving not only the intolerance of light, but also the inflammation itself, it appears to me probable, when I consider the kind and degree of vascular redness of the conjunctiva and the course of the disease, that there is not congestion and stasis, as in other cases; but, on the contrary, an unduly dilated state of the arteries, with a corresponding accelerated flow of blood, as after section of the sympathetic—a condition, we have seen, that the special action of belladonna on the arteries would be calculated to counteract.

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* See *Philosophical Transactions* for 1852.

The action of belladonna, along with the action of Calabar bean, on the pupil and on the adjustment of the eye, will come under special consideration when treating of the abnormal states of the Optical Refractions and Adjustments.

2nd.—*General.*—*Tonic and alterative treatment.*

Tonics are of extensive use in ophthalmic inflammation —sometimes to promote convalescence, after inflammation has been subdued by depletion and mercurialization—sometimes even in the height of the inflammation; thus n the scrofulous ophthalmiæ, quina has been shown by Dr. Mackenzie to be scarcely less efficacious than mercury s in iritis. Iron, zinc, the mineral acids, and cod-liver oil, are also useful in various cases, complicated with anæmia, dyspepsia, &c.

In chronic internal ophthalmia, the corrosive sublimate of mercury, as an alterative, given in conjunction or not with sarsaparilla, bark, &c., is a most useful remedy,—also iodide of potassium.

Arsenic has often been found of great use in cases of hronic sclerotico-choroiditis, as first pointed out by Dr. Mackenzie.

3rd.—*Local.*—*Antiphlogistic and soothing treatment.*

Local bleeding—*Leeches.*—Though in acute internal oph- halmia, leeches are inadequate to produce a very decided fect, they may often be usefully made to follow up venesection. Leeches alone are applicable in ordinary cases of onjunctivitis, corneitis, &c.

Scarification is very beneficial when the vessels of the alpebral conjunctiva are much gorged with blood, as in the purulent ophthalmiæ. When chemosis is present, incisions are made in the elevated conjunctiva, as above directed (p. 91); partly for the sake of relieving tension and partly for the abstraction of blood.

Counter-irritation is of much use in ophthalmic inflammation, after the acute symptoms have been subdued, and in chronic inflammations.

Cold and warm applications.—The cases in which cold applications are adapted, are conjunctivitis in its earlier stages, and injuries of the eye, in order to ward off or moderate the traumatic inflammation. In most other cases of ophthalmic inflammation, warm applications are preferable. But it is to be observed, that the choice of cold or warm applications may be in general best determined by the feelings of the patient.

4th.—*Local.—Irritating applications.*

It may be laid down as an axiom, that (to use the words of Dr. Mackenzie) in the internal ophthalmiæ, and especially in the acute stage, the application of stimulants is useless or destructive; while in conjunctival inflammations, more is effected by their means than by almost any other kind of remedy. Indeed, the plan of treatment adapted for acute iritis, if trusted to in severe conjunctivitis, would expose the eye to almost certain destruction.

Cases of internal ophthalmiæ, accompanied by great congestion of the conjunctiva, do occasionally occur, in which the opportune application of an irritant, by relieving the conjunctiva, promotes the subsidence of the internal inflammation.

But in regard even to conjunctival inflammations, it is to be observed, that as they are frequently dependent on the state of the constitution, or on an affection of some other organ, he who in treating them should direct his attention exclusively to the eye affected, might often exhaust his whole ophthalmic formulary in vain. On the other hand, however, it is not to be denied, that in many cases the inflammation is either purely local, or though connected with constitutional causes, can have its cure effected only by local treatment. This must not be overlooked; for though it has been more usually the error to treat ophthalmic inflammations as mere local affections, still some practitioners have run into the opposite extreme of neglecting local treatment entirely.

5th.—*Operations for the relief of intraocular distension and congestion.*

Evacuation of the aqueous humour by puncture of the cornea (*Paracentesis corneæ*).—This has been recommended as a remedy in ophthalmic inflammation. It operates, by relieving distension of the eyeball from increased accummulation of aqueous humour—a state attended by suffusion of the cornea, and the cause at once of considerable distress, and of a continuance of the inflammatory action.

The operation is simply the first step in making the section of the cornea for the extraction of cataract, only the point of the knife should be directed obliquely, as represented in the annexed figure. A cataract-knife is the instrument best adapted for the purpose. If the operation is undertaken when the eye is very intolerant of light, there may be some difficulty in exposing the cornea sufficiently for the purpose, as on the eyelids being opened, the eyeball is involuntarily rolled upwards. In such a case, especially if the patient be timid, it would be necessary to give chloroform. One eyelid requires to be secured by an assistant, while the surgeon takes charge of the other. The knife is entered at about one-thirtieth of an inch from the sclerotica, on the temporal and lower side. In doing this, the principal precaution to be observed is not to push the point on in the substance of the cornea, under the impression that it has penetrated into the anterior chamber. The extent to which the blade is pushed into the anterior chamber, should be such, that its point do not advance at all near the temporal margin of the pupil, so that were the aqueous humour suddenly evacuated, the iris might be between the point of the instrument and the lens. Hence the propriety of using an instrument of the shape mentioned, which is calculated to make a sufficiently large puncture without penetrating far into the anterior chamber, and directing its point obliquely downwards. The puncture having been sufficiently made, the instrument is to be withdrawn a little and slightly turned on its axis, so as to make the wound gape, and thus allow the aqueous humour to flow out. In propor-

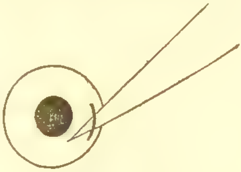

FIG. 34.

tion as this takes place, and the iris approaches the cornea, the knife is withdrawn.

The aqueous humour is regenerated in the course of twenty-four hours.

Whence is this regeneration of the aqueous humour derived? I think there can be no doubt that it is derived by exudation chiefly, from the blood circulating in the vessels of the very vascular ciliary processes which project free into the posterior chamber all round its circumference.

A very common answer to this question used to be, that the aqueous humour is secreted by the lining membrane of the aqueous chambers; but this is a statement not exactly in accordance with the received notions of the process of secretion, unless it be understood to refer merely to the detached cells seen suspended in the aqueous humour examined under the microscope, and which are no doubt thrown off from the surface of the walls of the aqueous chambers.

Another opinion, which has been enunciated of late years, is that the aqueous humour is derived principally from the surface of the iris by exudation or secretion. In disproof of this opinion, it may be enough to refer to the fact, that in a case of *irideremia* or congenital total absence of iris, in which I had occasion to perform the operation of *paracentesis corneæ* for an internal inflammation, regeneration of the aqueous humour took place as rapidly and completely as is usual in cases in which the iris is normally existent,—and to another fact, viz., that the whole iris has been torn away by accident, with at the same time loss of the aqueous humour, but in which case the aqueous humour, notwithstanding, has been duly regenerated.

It is about fifty years ago since the value of this operation was brought under the notice of the profession by Mr. Wardrop, in cases especially of anterior internal inflammation of the eye attended by dimness of the cornea. Considering that the dimness of the cornea was the result of intraocular pressure, Mr. W. punctured the cornea and evacuated the aqueous humour in order to relieve this pressure. Mr. W. was led to adopt the practice by reflecting on the fact, that if the eye of a sheep, for instance, be squeezed in the hand, the cornea becomes dim, but resumes its transparency when the pressure is relaxed.

Whether the dimness in this experiment be of the same nature as the dimness of the cornea in the inflammations of the eye under notice is a question of no practical consequence. It is enough for us to know that evacuation of the aqueous humour is a most valuable remedy in the treatment of corneitis and such anterior internal inflammations as involve the iris and cornea.

Such inflammations give rise to more copious exudation of aqueous humour, and the irritation resulting from the intraocular pressure occasioned by the increased accumulation keeps up the disease, and opposes the beneficial operation of the medicines employed. Relieve this source of irritation by evacuating the aqueous humour, and the inflammation will begin to yield to the action of the medicines it previously resisted.

Often a single performance of the operation is sufficient. Sometimes the operation may require to be repeated two or three times.

I have over and over again proved the value of this operation as an auxiliary of the medicinal treatment, in cases in which the inflammation was very stubborn, and by means of it have often preserved the eye from imminent destruction.

Iridectomy.—The lateral excision of a piece of the iris is an operation which has been long practised for the formation of artificial pupil, and has of late years been especially recommended as a *cure for glaucoma.*

When treating of glaucoma, I shall examine the claims of the operation to such a distinction. Here I speak of the operation only in so far as it has been found a means of promoting the subsidence of certain internal inflammations of the eye, especially arthritic posterior internal ophthalmia,—named also *acute glaucoma.*

In performing the operation, the best position for the patient is to lie on his back on a table, with his head sufficiently raised. In this position the patient's head is secured against any sudden backward movement, which might be fatal to the eye at the moment the iris is being drawn out, in order to be excised. If the patient is young, or not sufficiently firm, it will be found necessary to give chloroform.

Matters being thus so far arranged, the surgeon, having all his instruments ready at hand, takes charge of one eye-lid, and his assistant of the other. Then, at the side where it has been previously determined on to make the excision—usually above—he cuts through the cornea, concentric with, and on the sclerotic side of, its clear margin, into the anterior chamber, to the extent of about a quarter of its circumference. This section of the cornea may be effected by puncturation and counter-puncturation with a cataract-knife, as in making the section of the cornea for extraction of the cataract; or by a single puncture by means of this lancet-shaped knife. (Fig. 35.)

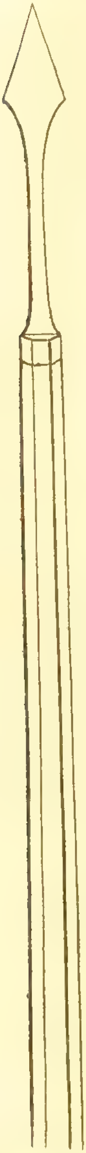

Fig. 35.

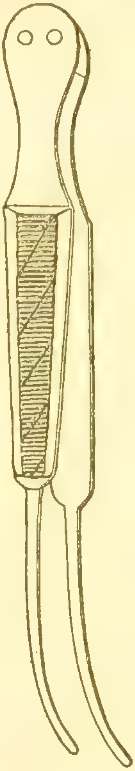

Fig. 36.

The section of the cornea having been made, the necessary result is escape of the aqueous humour. Another result, which generally takes place, is prolapse of the iris; that membrane being forced out through the opening in the cornea by the gush of aqueous humour which takes place at the moment of completing the section.

If the iris protrudes, the second step of the operation is performed by simply seizing the protruding iris with a fine forceps, such as this (Fig. 36), and dragging it further out, so that its pupillary margin may be included in the piece excised.

If, on the contrary, the iris does not of itself protrude through the opening, and cannot be made to do so by gentle pressure on the eye, it is necessary to enter the point of the forceps closed a little way into the anterior chamber, and then, opening the instrument, to seize the iris by pinching it up, and drag it gently out to the necessary extent. In performing this manœuvre, we must take care not to push on the point of the forceps so far as the pupillary margin of the iris, for fear of wounding the capsule of the lens—a wound of which membrane would induce opacity of the lens.

The excision of the protruded piece of iris is effected by means of this well-known form of scissors, curved on the flat. (Fig. 37.) In performing this act, the scissors are to be held, of course, with the convexity of the curve next the cornea, and with their length at right angles to the line of the section of the cornea, in order not to run the slightest risk of including a bit of the flap of the cornea in the excision.

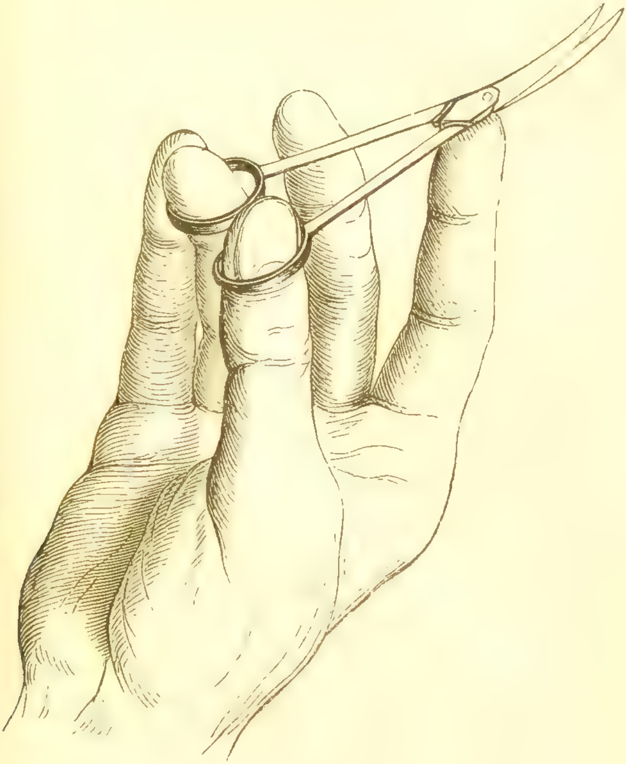

Fig. 37.

When the eye and iris are otherwise healthy, there is ittle or no bleeding from the cut iris. Matters are different when the operation of iridectomy is performed in the circumstances under which it is spoken of here. The iris, being in common with other parts of the eyeball the seat of great venous congestion, blood usually escapes in that case in very considerable quantity—so great as to fill the aqueous chambers.

The operation being completed, what is the state of the eye? By the evacuation of the aqueous humour, the vitreous body and lens are, by the elastic reaction of the coats of the eyeball, pressed forward against the remaining portion of the iris, and this, again, against the cornea.

The edges of the corneal incision very quickly adhere, so that when the eye is examined the second day after the operation, it is, perhaps, found that union has taken place; and that, as a consequence of the closure of the opening in the cornea, the aqueous humour has reaccumulated, and that the cornea is thus again plump.

The blood effused into the aqueous chambers at the time of the operation disappears by absorption—usually in a very short time.

The patient commonly recovers from the operation in a few days.

As to the mode in which subsidence of inflammatory congestion of the choroid and retina is promoted by iridectomy: Founding my opinion on what I have observed in the course of my researches on the state of the blood and the blood-vessels in inflammation, I believe that the excision of the bit of iris and the consequent evacuation of a small quantity of blood act by relieving the congestion of the choroid and retina, and thereby promoting in them a freer circulation. In fact, it is in a similar manner also that scarification of the palpebral conjunctiva operates so beneficially when that membrane is in a state of great inflammatory congestion. It is not the mere loss of blood that does good, for that is insignificant, but the emptying of some of the vessels, permitting of the re-establishment of the circulation in its activity in the part generally.

SECTION III.—THE OPHTHALMIÆ.

Ophthalmic inflammations, considered as a class, may be divided into four orders, viz. :—

I. OPHTHALMIA EXTERNA.
II. OPHTHALMIA INTERNA ANTERIOR.
III. OPHTHALMIA INTERNA POSTERIOR.
IV. PANOPHTHALMITIS.

The genera of these orders are distinguished and designated according to the particular structure which is the chief seat of the inflammation—I say the chief seat, for the inflammation is seldom confined altogether to a single structure.

Ophthalmia externa thus comprehends, according as the conjunctiva, sclerotica, or cornea is the chief seat of the inflammation, the genera

Conjunctivitis.
Sclerotitis.
Corneitis.

Ophthalmia interna anterior, on the same principle, comprehends the genera

Aquo-capsulitis.
Iritis.
Kyklitis.

Ophthalmia interna posterior, again, comprehends the genera

Choroiditis.
Retinitis.
Vitreo-capsulitis.
Zonulitis.

Panophthalmitis is both order and genus.

The circumstances which principally distinguish and give name to the species and varieties of the ophthalmiæ, are—1, the particular part affected of the structure which is the chief seat of the inflammation—2, the structures which are co-affected—3, the nature of the exciting cause—4, the state of the constitution, or the constitutional disease by which the inflammation appears to be modified—5, the nature of the event of the inflammation.

Cases of ophthalmia are of constant occurrence in which there have been repeated attacks of inflammation throughout a series of years, and of which the result consists in various changes of structure and affections of sight, but of which cases, the phenomena, objective and subjective, are such that they can scarcely be referred to any particular heading.

Order I.—OPHTHALMIA EXTERNA.

The order of ophthalmia externa comprehends the genera conjunctivitis, sclerotitis, and corneitis. Each of these, as has been shown, may be more or less complicated with some degree of the other; but when the conjunctiva and sclerotica, or conjunctiva and cornea, or the conjunctiva, sclerotica, and cornea, are equally affected at the same time, then the case must be considered as coming under the head of a fourth genus, viz., compound external ophthalmia.

Genus I.—CONJUNCTIVITIS.

The species of conjunctival ophthalmia are:—*pustular*, *catarrhal*, the different forms of *purulent ophthalmia*—viz., *Egyptian*, *gonorrhœal*, *ophthalmia neonatorum*—to which may be added the ophthalmia sometimes met with in female children in connexion with puromucous vaginal discharge—*pseudo-membraneous* or *diphtheritic ophthalmia*, and *erysipelatous ophthalmia*.

1st.—*Pustular ophthalmia*.*

This name is confined to the cases in which the pustules are situated on the sclerotic conjunctiva—a tenth or a twentieth of an inch from the margin of the cornea, or close to the margin of the cornea, but not on the cornea.

Objective symptoms.—To the objective description of pustular inflammation of the conjunctiva above given

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* Aphthous or papular or herpetic conjunctivitis.

(p. 101), all that requires to be added here is, that the cornea is quite clear—that there is no decided lacrymation, though a flow of tears is readily excited by the movements of the eye—and that there is, with congestion of the palpebral conjunctiva, an increased Meibomian discharge, sufficient, perhaps, to cause gluing together of the eyelashes over night.

Subjective symptoms.—There is not the slightest intolerance of light, or perhaps any other local inconvenience, except a sensation like that from a foreign body in the eye, which is excited by the pustule and its enlarged vessels. It is not, however, distressing, in consequence of the general sensibility of the conjunctiva not being exalted.

Constitutional symptoms.—There is little or no constitutional disturbance.

When pustules present themselves close to the margin of the cornea (p. 105), the subjective symptoms may be as slight as above described; but the case in which this occurs is apt to pass into, if it is not already, one of scrofulo-catarrhal, or of phlyctenular corneitis, or common scrofulous ophthalmia, which is attended with great intolerance of light and lacrymation.

Causes.—Pustular ophthalmia occurs in children and young adults, especially females. It is usually excited by exposure of the eye to a draught of air. In a little boy, for example, it was brought on by looking through the keyhole of a door and receiving on the eye the current of air passing through.

Diagnosis and prognosis.—Practically, it is of importance not to confound pustular ophthalmia with phlyctenular. In the former, the application, two or three times repeated, of some irritating collyrium, will seldom fail to cure; whereas in the latter, the curability is entirely different. Seeing that when the pustules are at the margin of the cornea, the case is apt to be mixed up with phlyctenular ophthalmia, the curability is under such circumstances modified. The combination with catarrhal or scrofulo-catarrhal ophthalmia, has not so great a modifying influence.

Treatment.—Any application, such as the nitrate of silver drops (p. 83), or red precipitate salve (p. 85), or, as recommended by Dr. Foucher, in the French translation of this work, a solution of tannin (gr. x.—xx.), in glycerine (℥j), &c., applied to the eye, at intervals of a day or two, will in general suffice for the cure. The vascular congestion speedily disappears, and, *pari passu*, healing of the abrasion left by the pustule takes place. All the general treatment that may be necessary, is a dose of hydrargyrum cum cretâ, followed by a purgative and afterwards a tonic.

The above treatment is applicable, though not so rapidly effectual, when pustular is combined with catarrhal or scrofulo-catarrhal ophthalmia. When pustular is complicated with phlyctenular ophthalmia, the treatment is that applicable to the latter.

2nd.—*Catarrhal ophthalmia.**

Catarrhal ophthalmia is usually considered the type of conjunctival inflammation; for it is the form which inflammation of the conjunctiva, excited by other causes besides atmospheric influence—injury, for example—is most prone to assume.

Objective symptoms.—The eyelids are somewhat red and swollen, especially at their edges—the upper eyelid may be so much swollen as to overlap the edge of the lower. The white of the eye is bloodshot, and on examination this is found to be owing to the reticular vascular injection above described, as characteristic of inflammatory congestion in the conjunctiva (p. 105). Besides the vascular injection, there are sometimes interspersed spots of ecchymosis (p. 106).

On everting the lower eyelid, it is seen, that towards the palpebral sinus, the redness of the sclerotic conjunctiva is more intense, and that the palpebral conjunctiva, at the same time that it is very red, is thickened and velvety-looking. The semilunar fold and lacrymal caruncle are red and swollen. (Plate I., fig. 1.)

In the severer cases, in which the vascular injection of the sclerotic conjunctiva extends to the very margin of the cornea, there may be some degree of chemotic elevation of the conjunctiva, especially at the lower margin of the cornea.

The cornea may remain quite clear, and the colour and activity of the iris unchanged.

There is at first watering of the eye, the result, partly, of the serous exudation from the conjunctiva, above mentioned (p. 106), but by-and-by a puromuculent discharge takes place. The matter accumulates in greater or less quantity at the inner corner of the eye, and in flakes in the palpebral sinuses. On everting the lower eyelid, a flake of exfoliated epithelium, with puromucus, will perhaps be seen. Films of this matter, getting on the surface of the cornea every now and then, occasion transitory dimness and iridescence of vision. The eyelashes, also, are besmeared with the secretion; but another source of the matter, which is found incrusting them, and gluing the eyelids together over night, is the secretion of the Meibomian glands, which is poured out in increased quantity.

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* Simple conjunctivitis.—Blepharophthalmo-conjunctivitis catarrhalis.—Ophthalmia purulenta mitior.

The watering of the eye at the commencement, as has been hinted, does not appear to be wholly the result of lacrymation, but partly of serous exudation from the congested vessels of the conjunctiva. A flood of tears, however, occasionally takes place.

Subjective symptoms.—Itchiness and smarting at the borders and angles of the eyelids, heat, and the sensation as if a foreign body were in the eye, are the subjective symptoms which usually usher in an attack of catarrhal ophthalmia.

There is not much intolerance of light, though there is a greater or less desire to shade the eye, and a feeling of weakness of it. The eyelids feel stiff, heavy, and tense. When the upper overlaps the lower, a very disagreeable sensation is experienced.

The discharge of tears, which occasionally takes place, s followed by temporary relief; and when the puromucuent secretion is established, the itchiness and smarting of he edges of the eyelids, and the sensation as if a foreign body were in the eye, are relieved.

There may be pain across the forehead, and in the region of the frontal and maxillary sinuses, but there is no pain like rheumatism around the orbit nor in the emples.

An exacerbation of the symptoms takes place towards vening; but the sensation as if a foreign body were n the eye, is felt much on first moving the eye in the morning.

Constitutional symptoms.—In general, there is not much r any constitutional disturbance; but the patient may be t the same time affected with a general catarrh.

The following is a good example of a case of catarrhal ophthalmia:—

A. B., æt. 26. One day, about noon, felt a tickling in the eye, which gradually increased until it passed into severe pain, as if sand were in the eye. Towards midnight the distress became very great, entirely preventing sleep. Next day when the patient applied for advice, I found on examination great vascular injection of both palpebral and ocular conjunctiva, with patches of ecchymosis in the latter. Cornea quite clear. Iris and pupil natural. Little or no intolerance of light. Some lacrymation. Pain across the forehead, but none in the temples. Bowels confined. Labouring under general catarrh.

Predisposing causes.—The patient may be of any age, of either sex, and otherwise healthy; but it is often the case that he has been for some time out of health, or has been over-exerting the eyes.

Exciting causes.—This form of inflammation, though conventionally called catarrhal, may be excited, as above mentioned, by irritation or injury of the conjunctiva. It is in the majority of instances, however, excited by atmospheric influence. In this case it may occur epidemically. In some places it is so common, that it might be considered endemic. Under these circumstances, it is usually of a very severe form, partaking more of the characters of Egyptian ophthalmia in its milder degrees—like which, also, it sometimes appears to spread by contagion.

Very generally both eyes are affected, but one is usually more so than the other.

Diagnosis.—Simple catarrhal is, in general, distinguished from the other forms of puromucous ophthalmia, in not presenting such a degree of redness and swelling of conjunctiva, copiousness of the puriform discharge, nor swelling of the eyelids, and by the circumstances under which it occurs.

The ophthalmiæ from which catarrhal conjunctivitis requires to be principally distinguished, are phlyctenular and catarrho-rheumatic,* the former occurring in young persons, the latter in adults.

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* Catarrhal ophthalmia is not likely to be confounded with rheumatic ophthalmia or sclerotitis. The difference in the seat and character of the vascular injection has been above pointed out (pp. 19, 109), and the difference in the accompanying pain (pp. 61. 130.)

In phlyctenular ophthalmia, the conjunctival vessels, which are injected, are few in number, and ramify singly or in detached fasciculi towards the conjunctival circumcorneal network, which may be completely or partially injected. There is also some sclerotic circumcorneal injection. The general expression of the redness in phlyctenular ophthalmia is thus, different from what obtains in catarrhal ophthalmia, a faint blush on one side or all round the cornea, shaded off towards the circumference of the eyeball, together with a fasciculus of vessels perhaps, proceeding to some point on the cornea where there is an ulcer. (Plate I., fig. 3.)

In phlyctenular ophthalmia, the cornea, which is the essential seat of the disease, early becomes suffused, or presents phlyctenulæ, which, bursting, leave ulcers. In catarrhal ophthalmia, although ulceration of the cornea may eventually take place, the cornea is quite unaffected at first.

In phlyctenular ophthalmia there may be little or no increase of the Meibomian secretion, or of the mucous secretion of the conjunctiva, which are such prominent characters in catarrhal ophthalmia. But in phlyctenular ophthalmia there is great lacrymation and intolerance of light; whereas, in catarrhal ophthalmia, these symptoms are slight or altogether absent.

But it is to be remarked that phlyctenular and catarrhal ophthalmiæ may occur in combination, constituting scrofulo-catarrhal ophthalmia. Catarrhal may also occur in combination with pustular ophthalmia. Cases even occur of a combination of catarrhal, pustular, and phlyctenular ophthalmiæ.

The differences between catarrhal and catarro-rheumatic ophthalmiæ are:—In catarrhal ophthalmia, there is simply conjunctival injection—in catarrho-rheumatic, both conjunctival and sclerotic. Hence, while in catarrhal ophthalmia, the sclerotic is observed white under the vascular network of the conjunctiva, it is pink in catarrho-rheumatic ophthalmia.

While in catarrhal ophthalmia, unless severe and of ong continuance, the cornea is clear, and the colour and motions of the iris natural, in catarrho-rheumatic ophhalmia, the cornea appears muddy, and not unfrequently presents a phlyctenula or ulcer, and the iris is discoloured, nd pupil sluggish. There is considerable intolerance of ght in catarrho-rheumatic ophthalmia; and instead of the pain across the forehead, or in the frontal sinuses, which may exist in catarrhal ophthalmia, there is more or less severe circumorbital or temporal pain, aggravated when the patient is warm in bed.

Prognosis.—Catarrhal ophthalmia, in its simpler forms, is in general readily subdued; and that in a week or a fortnight. In its severer forms, if neglected or improperly treated, ulceration of the cornea may take place, and, above all, the palpebral conjunctiva is extremely apt to be left in a state of chronic inflammation—itself thickened, and its papillæ enlarged—a state which keeps up irritation of the eye, and which may lead to vascularity and opacity of the conjunctiva corneæ. In this, as also in the other puromucous ophthalmiæ, entropium and ectropium are not unfrequent results.

Treatment.—In the simpler forms of this ophthalmia, if the case is seen at the very commencement, an attempt should be made to subdue the inflammation by soothing treatment. For this purpose, rest, quiet, and restricted diet should be enjoined, and a purgative of calomel and jalap, for example, prescribed; or an emeto-cathartic, especially if there is more than usual sensibility to the light—two grains of tartar emetic, and an ounce of Epsom salts, may be dissolved in half a pint of water, and two or three table-spoonfuls of the solution taken every half hour until vomiting; after which the same dose every four or six hours only.

As applications to the eye, lotions of tepid water three or four times a day, or, if more agreeable, the continued application of cold. The continued application of cold lotions, however, it is to be remarked, is apt, in middle-aged persons particularly, to excite sclerotic inflammation, and thus convert a catarrhal into a catarrho-rheumatic ophthalmia. As an occasional application, cold water is not well adapted. When used as such, an uncomfortable sensation of heat in the eye is felt soon after; whereas, when tepid water has been used, the eye for a time feels pleasantly cool. At bed-time the borders of the eyelids are to be anointed with simple ointment.

Under this soothing treatment, the inflammation will sometimes subside without any thing further being necessary; but if resolution does not begin to take place within twenty-four hours or so, irritating collyria will require to be used. The nitrate of silver solution, for example, may be dropped into the eye every other day, and the alum, bichloride of mercury, or lapis divinus lotion, without addition of vinum opii (p. 81), used tepid, to bathe the eye three times a day. At bed-time the borders of the eyelids may be anointed with the weak red precipitate salve (p. 85).

If, notwithstanding this treatment, the inflammation persists, it will be proper to apply leeches—about six around the eye, or each eye, if both be affected.

In the severer forms of the complaint, blood should be at once abstracted, either by leeches as above, or if the patient be robust, by venesection, followed up, if necessary, by leeches. This treatment will save much subsequent inconvenience from a thickened state of the palpebral conjunctiva. After the bleeding, a pediluvium, and some diaphoretic, such as Dover's powder, at bed-time, are to be prescribed, and a purgative draught in the morning. Locally, the same treatment as above indicated.

As the inflammation remits, the redness of the sclerotic conjunctiva becomes less and less until it has quite disappeared; but though this has taken place, considerable congestion may still be presented by the palpebral conjunctiva, with enlargement of its papillæ. If this state of the palpebral conjunctiva continue obstinate, blisters behind the ears, scarification of the palpebral conjunctiva, and the pencilling of it with the strong red precipitate ointment, will be useful. When the palpebral conjunctiva is merely left relaxed and thickened, pencilling it a few times, at intervals of two or three days, with vinum opii, pure, or diluted with one or two waters, or with the lapis divinus drops, will do good. A return to generous diet, and the use of tonics, are at the same time to be enjoined.

3rd.—*Egyptian ophthalmia.*[*]

This is the disease of the eyes which so severely affected the English and French troops in Egypt, and also after their return thence, and which has since raged in the armies of almost all the states of Europe.

The palpebral conjunctiva and semilunar fold are especially the focus of the disease; being the parts which are from the first, and continue to the last affected, whatever other parts may be also involved. But though the inflammation may thus remain almost entirely confined to the palpebral conjunctiva, it is peculiarly disposed to extend, and that with great violence, to the ocular conjunctiva, and even to the proper tunics of the eyeball itself. On this extension of the inflammation, depends the rapid destructiveness to the eye, which has so lamentably characterised the disease.

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[*] Granular or contagious ophthalmia.—Ophthalmia purulenta gravior.—Ophthalmia militaris, &c.

Different degrees of the ophthalmia—a first, a second, and a third degree—are accordingly recognised.

In the first degree, the inflammation is still in a great measure confined to the palpebral conjunctiva and semilunar fold; and, though there are flakes of puromucous secretion suspended in the tears, there is no decided blenorrhœa.

In the second degree, the inflammation has extended to the ocular conjunctiva, which is raised up by exudation into a chemotic ridge at the margin of the cornea—usually the lower first—and there is more or less blenorrhœa, or discharge of puriform matter (not mixing uniformly with the tears).

In the third degree, the chemosis is complete, the eyelids are enormously swollen, there is profuse discharge of mucopurulent, or actually purulent, matter (mixing uniformly with the tears), and the proper tunics of the eyeball are either already involved, or in imminent danger of becoming so.

The disease may not advance beyond the first degree, but become chronic, or it may at once pass into the severer degrees. In its chronic state it is still ready, on the application of any exciting cause, to pass into the severer degrees.

The second degree may arise at once as such, or be developed from the first degree.

The second degree has a great tendency either to become chronic or to pass into the third degree, and this especially if neglected or improperly treated. The third degree, indeed, generally, if not always, arises by a sudden aggravation of all the symptoms from the milder degrees, especially the second.

The morbid development on the conjunctiva of the eyelids and palpebral sinuses of what are called *granulations*, is an early and important effect of the inflammation. The nature of these granulations has been above pointed out (page 107.) Plate I., fig. 2.—Plate II., fig. 1.

The development of a granular state of the palpebral conjunctiva is often the result of long continued but slight congestion—so slight as scarcely to have attracted the patient's attention. Hence it has been maintained, that the formation of granulations takes place independently of inflammation; and when, in such cases, ophthalmia declares itself in a decided form, it has been alleged to be an effect or symptom of the granular state of the palpebral conjunctiva. But this is incorrect.

Both eyes, commonly, are affected, though one may suffer more than the other. When both eyes become affected, there is often an interval of some days between their first invasion.

The lower eyelid is usually first affected, but the upper soon becomes so and suffers more than the lower—it, indeed, remains the nest of the disease.

Local symptoms in first and second degrees.—The *first* and *second* degrees of Egyptian ophthalmia do not essentially differ in their symptoms, either objective or subjective, from the milder and severer forms of catarrhal ophthalmia, except in the granular state of the conjunctiva, which, though it does in some degree exist in inveterate cases of catarrhal ophthalmia, presents itself in Egyptian ophthalmia even from the first, and remains to the last, so that it is justly considered the peculiar characteristic of the disease.

Constitutional symptoms in first and second degrees.—In general, there is no constitutional disturbance—no fever—no loss of appetite. When such do occur, they depend rather on the idiosyncrasy of the patient than on the disease.

Objective symptoms in the third degree.—In the third degree, the eyelids, especially the upper, are very much swollen, sometimes enormously so, tense, livid, and hot. The upper eyelid hangs down over the lower.

If an attempt be made to open the eyelids, or even when the patient makes any effort whatever, protrusion of the conjunctiva of the palpebral sinuses, and eversion of the eyelids, are apt to take place, in consequence of the swollen and sarcomatous state of the conjunctiva, as well as the effusion beneath it. The eversion of the eyelids is at first reducible, but by-and-by it may cease to be so.

The semilunar fold and lacrymal caruncle are so red and swollen, as to look like sarcomatous excrescences rather than natural structures.

The sclerotic conjunctiva, likewise red and swollen, is raised up like a wall all round the cornea, which thus appears half buried (*chemosis*). The cornea may be as yet unaffected.

After some hours, the secretion of the conjunctiva, which was sero-muculent, becomes muco-purulent, or actually purulent (mixing uniformly with the tears), and is poured out in such quantity, that it is constantly flowing down the cheek. If the eyelids are suddenly opened, the matter bursts out in a torrent.

An oozing of blood readily takes place from the conjunctival surface.

The inflammation does not remain confined to the conjunctiva, but extends to the proper tunics of the eyeball, the sclerotica, the cornea, and even the internal tunics. When the eyelids admit of being opened, the implication of the cornea can be seen, but that of the other parts is inferred from the subjective symptoms. When the eyelids cannot be opened, and the cornea seen, something may be inferred as to the degree to which it has suffered from the state of the discharge; if ill-conditioned, there is reason to dread mischief to it.

The cornea, though it sometimes escapes immediate material injury, is the part most subject to the destructive effects of the inflammation. It becomes more or less opaque from exudation into its substance. Its conjunctival layer may become thickened, opaque, vascular, and covered with fungous excrescences,—or phlyctenulæ form, burst, and run into perforating ulceration, which is followed by prolapsus iridis. In the worst cases, the cornea becomes wholly infiltrated with exuded matter, and is rapidly and completely destroyed by ulceration, or by mortification and sloughing. Sometimes it bursts, but probably not before being thinned by ulceration. Even if it should have escaped these destructive effects, an ulcerated trench will probably be found, when the swelling of the parts subsides, at the place where it was pressed on by the chemosed conjunctiva.

Subjective symptoms in the third degree.—The severity of the subjective symptoms in this degree of the disease, is principally owing to implication of the proper tunics of the eyeball—the sclerotica, the cornea, and even the internal tunics.

There is burning hot pain in the eyelids, aggravated by the slightest touch, deep distending pain in the eyeball, and pain around the orbit, in the temple, or all over the side of the head. There is great intolerance of light, and often photopsy.

The pain around the orbits and in the temples occurs in nocturnal paroxysms, during one of which the cornea bursts. On the bursting of the cornea, the pain immediately remits, but returns again in another form, or passes to the opposite eye.

Constitutional symptoms in the third degree.—Even in the third degree, the constitutional symptoms are not severe. In some exceptional cases, indeed, before the disease has reached its greatest height, a symptomatic inflammatory fever arises, but is, notwithstanding the severity of the local affection, very moderate, and does not continue long. In the progress of the disease, however, the patient is liable to become much sunk both in strength and spirits.

Causes.—The cause of this disease was at one time supposed to be a peculiar contagion, first imported into Europe from Egypt (hence the epithet Egyptian) by the English and French armies. It is now, however, pretty generally conceded, that the disease does not depend upon any such peculiar contagion, but that it may arise from occasional atmospherical influences, sometimes sporadically, sometimes epidemically. There are also local influences which render it endemic, in many other places besides Egypt.

The disease, in a more or less latent state, is common among the Irish poor, both in Ireland and in this country.

In whatever way it arises, it may, under favouring circumstances, as when large bodies of people are crowded together, and especially in dark, dirty, damp, and ill-drained dwellings, become infectious. This is the explanation of its propagation in armies, schools, and prisons.

It has been supposed that propagation takes place principally by infection *per contactum;* but experience appears to show that infection *in distans* is the more common way,* the air being the vehicle by which the infecting principle is conveyed in the latter case, the discharge from the eye in the former.* The communication by contact has often taken place from the use in common of towels, basins, &c.

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* Eble, Die so-genannte contagiöse oder ägyptische Augenkrankheit. Stuttgardt. 1839.

Though the disease has prevailed in the most opposite climates, and in all seasons, still it appears that a very warm, or a warm and damp climate or season, is peculiarly favourable to its development and propagation.

As causes predisposing the individual to be attacked, may be mentioned fatigue, exposure, want of cleanliness, improper food, abuse of spirituous liquors, &c. The invasion of the disease is often sudden—soldiers on guard, and numbers of persons in the course of one night becoming affected. This has no doubt been owing to atmospherical influence favouring the development of the morbid germ already under incubation.

Diagnosis.—It has been above shown, that the principal difference between catarrhal ophthalmia and the milder forms of Egyptian ophthalmia, consists in the great degree in which the conjunctiva of the eyelids is affected with granulations in the latter,—a morbid state, which is very inveterate, and by its presence keeps up irritation and a tendency to relapse.

The severest degree of Egyptian ophthalmia is to be distinguished from the other forms of purulent ophthalmia, gonorrhœal, for example, principally by the circumstances of the case—and by this, that in true gonorrhœal ophthalmia one eye only is usually affected, and the ocular conjunctiva is perhaps more swollen, the eyelids less so.

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* Piringer (Die Blennorhoë am Menschenauge. Gratz, 1841) has made a number of experiments to reproduce the disease, by the application of matter from an affected eye, for the purpose of curing pannus, as will be explained in the proper place, and the results he has come to in regard to the contagion of the disease, are the following :—The contagion is fixed, its vehicle the muciform secretion of the conjunctiva. The mucus of the second and third degree of the disease only is absolutely infectious ; as the secretion becomes thinner, it loses its infectious power. Eyes which have been already diseased, appear to be less readily infected than perfectly sound eyes. The activity of the mucus is not retained beyond the third day after its removal from the body ; the reaction takes place in from six to twenty-four hours, usually at night. The degree of the disease excited by the infection, depends on the quality of the contagion. Mucus from the first degree of the disease, or thin secretion from the second and third, occasions the first degree of the disease. Secretion from the second degree of the disease excites the third degree. The application of ice-cold water, and cleansing the eye, within three minutes after the matter has been applied, prevent the operation of the infection.

Prognosis in general.—When the inflammation is of an active character, and not modified by any constitutional peculiarity, early and proper treatment promises success. When the inflammation is of a torpid character, and when the constitution is scrofulous, it less readily yields to treatment, subsides less quickly and perfectly, and fixing itself in the structures of the eye, is apt to produce degeneration of it. In erethitic irritable cases, the prognosis is also unfavourable, but less so than in torpid cases.

Sporadic cases are usually of middling severity. In an epidemic, the disease is at first mild, then increases in severity, and again becomes milder towards the end. When the disease is endemic, the cases, without being of the severest character, are in general very inveterate, if neglected.

The disease arising from contagion is more dangerous than when otherwise produced.

Prognosis in the first degree.—The disease in the first degree may in general be readily subdued. If not timely and properly treated, the disease may at once pass into the severer degree, or fall into a chronic state. In this state, however, it is still ready, on the application of any exciting cause, to rise into the severer degree.

Prognosis in the second degree. — The disease in the second degree, if taken in time and properly treated, may still be cured in three or four weeks. But if the inflammation has already been going on for a week or so, even if the cornea is still unaffected, though the inflammation may be readily removed from the sclerotic conjunctiva, the palpebral conjunctiva will remain long in a thickened and granulated state.

When the disease has become fully developed before medical assistance is called for, vascularization and ulceration of the cornea may have taken place. This affection of the cornea is kept up, if not aggravated, by the morbid state of the palpebral conjunctiva; hence the prognosis is very unfavourable, as opacity and permanent vascularity of the cornea may result.

Prognosis in the third degree.—In the third degree of the disease, a perfect cure is seldom effected. If the eye is not disorganised, which it may be in 24—36 hours, by destruction of the cornea, it may be very much injured by perforating ulceration and its consequences. Besides this, the morbid state in which the conjunctiva is left is long of being recovered from, perhaps never perfectly, and is a constant source of irritation.

Treatment.—In the first degree, the treatment should consist in scarification of the palpebral conjunctiva, and the application, once a day, of the nitrate of silver drops (p. 83), or the strong red precipitate ointment (p. 85), any accumulated discharge having been first gently pressed out by moving the eyelids backwards and forwards, and wiped away with small pieces of lint.

If chemosis already exists, and if the cornea appear much buried and pressed on by it, incision of the chemosed ocular conjunctiva ought to be had recourse to without delay (p. 91). Incision of the chemosed conjunctiva relieves the eyeball, and especially the cornea, from the pressure which is considered, as above mentioned (p. 118), to be one great cause of its destruction.

Besides incision of the chemosed conjunctiva, slitting the eyelids near the outer canthus through their whole thickness, from the tarsal border towards the orbital margin, is a proceeding which I can recommend from experience as one calculated still further to relieve the cornea from pressure, and so save it from destruction. Slitting up the external canthus would be preferable, but it scarcely affords sufficient relief to the pressure. When the swelling of the eyelids subsides, the slits are found to be of small extent and they readily heal up, so that a slight notch only remains at the tarsal border of the eyelid.

After the scarification, incision of the chemosis, and slitting of the eyelids, the application to the conjunctiva of strong irritants should be made, as nitrate of silver in substance, salve, or solution, or the strong red precipitate salve once a day, and the eye bathed and cleansed frequently with the tepid solution of alum, or of bichloride of mercury (p. 81).

When the iris and other internal structures of the eyeball become affected, as is indicated by change of colour of iris and contraction of pupil, provided these can be seen, and, if they cannot be seen, by pulsative pain in and around the eye, with inflammatory fever, the propriety of abstraction of the blood, either by venesection or leeches, will come under consideration. It will, in any case, be proper to give calomel, gr. ij., and opium, gr. ss. every four hours, until the gums are affected, and to foment the eye with belladonna or atropia lotion.

When the violence of the inflammation has subsided, it will be advantageous to improve the diet and give tonics, —quinine or bark. Also to make counter-irritation behind the ears or on the nape of the neck.

The special treatment of granular conjunctiva, of pannus, of ulceration of the cornea, prolapsus iridis, &c., which may present themselves as the effects of the inflammation, will be treated of under the proper heads.

Eversion of the eyelids sometimes occurs, as has been above said, p. 165. The palpebral conjunctiva, in consequence of its great tumefaction, being easily forced outwards by the action of the orbicularis palpebrarum. If the protrusion is not immediately returned, the upper part of the eyelid and the retroverted cartilage act like a ligature on the protruded conjunctiva; and, as the swelling increases, the stricture becomes still stronger by the contraction of the orbicularis.

This eversion of the eyelids urgently calls for the slitting of the eyelids above recommended to relieve the eye from the pressure. After the operation, protrusion of the conjunctiva persists to some extent, but as the swelling subsides, the eyelids regain their natural position.

Prevention of the spread of the disease in barracks, schools, workhouses, &c.—The matter from an eye affected with purulent ophthalmia, if applied to a healthy eye, will, we have above seen, excite a similar inflammation. Even without actual contact, contamination of the air, by having matter dissolved in it, appears to be a common mode of propagation.

When the disease is prevalent among a number of people necessarily collected together, the healthy should be immediately separated from the diseased, and the eyes of the healthy should be inspected daily. As a person may be affected with the disease in a latent, simply granular state without being aware of it, inspection is the only means of determining whether a person is healthy or not.

Each person ought to have his own towel and a separate portion of water for washing. Every care ought to be taken to keep healthy new comers apart from the affected, and on the other hand to guard against the introduction of a diseased person among the healthy.

By the discharge of diseased soldiers, and their return to private life, the ophthalmia has often been propagated among the lower classes of civilians.

4th.—*Gonorrhœal ophthalmia.**

A most dangerous inflammation of the eye,—one indeed which is often rapidly fatal to the sight,—is sometimes occasioned by the accidental application of the matter of gonorrhœa to the eye.

Diagnosis.—This ophthalmia resembles very much the severest form of Egyptian ophthalmia. If there is any difference, it is this:—In gonorrhœal ophthalmia, the sclerotic conjunctiva is affected from the very first, and great and inveterate chemosis rapidly forms:—whereas in Egyptian ophthalmia, the sclerotic conjunctiva becomes affected subsequently to the palpebral conjunctiva, the chemosis does not form so rapidly, nor is it so inveterate. In gonorrhœal ophthalmia, though the inflammation of the palpebral conjunctiva and swelling of the eyelids may be very great, it is in general not so considerable as in Egyptian ophthalmia; and, at any rate, granulated conjunctiva is not so marked a character of gonorrhœal as of Egyptian ophthalmia.

In consequence of the greater severity of the inflammation of the sclerotic conjunctiva, the cornea is still more liable to suffer and be destroyed in gonorrhœal than in Egyptian ophthalmia. Indeed, gonorrhœal ophthalmia is one of the most rapidly destructive diseases the eye is subject to.

Males are oftener affected with the disease than females; but it is of comparatively rare occurrence in either sex. It is sometimes met with in children.

In general one eye only is affected in gonorrhœal ophthalmia; whereas in Egyptian ophthalmia, it is extremely rare to meet with a case in which the disease remains confined to one eye.

These differences, it will be observed, are not sufficiently strict to serve as a practical ground of diagnosis. The history of the disease forms the best criterion.

Cause.—Inoculation with gonorrhœal matter. The matter is sometimes accidentally applied to the eye of a healthy person through the medium of foul cloths, &c. It is in this way that children are inoculated. I have seen a little girl have her eye destroyed by the disease, having been inoculated by washing her face with a cloth which her father had been using in wiping away his gonorrhœal discharge.

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* Ophthalmia gonorrhoica vera—Acute gonorrhœal inflammation of the conjunctiva.

Inoculation with the matter of gonorrhœa is not unfrequently the cause of the ophthalmia of new born infants, when the mother labours under that disease at the time of her confinement.

Prognosis.—Until, with a cornea safe, or at least not much ulcerated, the disease is on the decline, which is known by the subsidence of the swelling of the eyelids and of the chemosis, with diminution of the discharge, the prognosis must be extremely unfavourable. The eye may be destroyed in forty-eight hours from the commencement of the disease. Even when the eyeball is not actually destroyed, it may be left atrophic and vision annihilated.

Treatment.—The treatment must be the same as in the severest form of Egyptian ophthalmia, only, if possible, more active. No delay of treatment can be admitted. Incision of the chemosed conjunctiva should be early had recourse to, and also slitting of the eyelids near the outer canthus, through their whole thickness from the tarsal border towards the orbital margin, as described under the head of treatment of Egyptian ophthalmia. In a case of gonorrhœal ophthalmia, after incising the chemosed conjunctiva, I slit up the upper eyelid and left the lower untouched. The upper part of the cornea was saved, but penetrating ulceration took place at the lower part, where it was slightly pressed on by the edge of the lower eyelid.

5th.—*Mild gonorrhœal ophthalmia.*

A milder form of ophthalmia is met with in persons labouring under gonorrhœa, which, however, does not appear to differ from common catarrhal ophthalmia. The cases of the kind which I have seen have not appeared to me in any other way dependent on gonorrhœa, than that, at the time, the system was, in consequence of it, more susceptible to cold. The exposure to which, at the same time that it excited the ophthalmia, operated in checking the discharge from the urethra.* They readily yielded to the same treatment as is above indicated for catarrhal ophthalmia.

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* Iritis, in connection with gonorrhœa, will be considered farther on, under the head of *Gonorrhœal rheumatic Iritis.*

Sometimes the inflammation presents the characters of, and requires then the treatment for, catarrho-rheumatic ophthalmia.

6th.—*Puromucous ophthalmia occurring in female children, in connexion with puromucous discharge from the vagina.*

This ophthalmia, though sometimes severe, is usually of a mild character.

Symptoms.—In a case of two or three days standing, the eyelids were red and swollen, but not tense, and admitted of being readily opened. The conjunctiva was red but not intensely so—the palpebral conjunctiva spongy—the sclerotic conjunctiva raised up over the lower margin of the cornea in a state of slight chemosis. The cornea was still quite clear. There was a serous discharge, mixed with considerable flakes of thick whitish-yellow matter. No pain, and little or no intolerance of light.

Treatment.—Scarification of the palpebral conjunctiva—the nitrate of silver drops once a day—the alum lotion two or three times a day for cleansing the eye—the red precipitate ointment to the edges of the eyelids at bed-time and some laxative medicine—checked the inflammation in a few days. The healing process was then promoted by a blister behind the ear, pencilling the conjunctiva with lapis divinus drops, and the exhibition of quina.

When the chemosis subsided, superficial ulceration was discovered where the cornea had been pressed on by the fold of conjunctiva. This readily healed, leaving a slight opacity, and was the cause of retarding somewhat the recovery.

The vaginal discharge subsided under the use of a sulphate of zinc injection.

The occurrence of vaginal discharge in female children has sometimes unjustly excited a suspicion of the child having been violated.

7th.—*Purulent ophthalmia of newborn infants.**

It is generally within a week after birth that this ophthalmia makes its attack. Sometimes it is observed immediately after birth, sometimes, again, as late as three or four weeks.

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* Ophthalmia neonatorum.

Objective symptoms.—It is first noticed, that the infant keeps the eyes shut, that the edges of the eyelids are slightly œdematous and red, and that they are gummed together after sleep with an inspissated yellow matter, which is the Meibomian secretion increased in quantity. On softening this, and separating the eyelids, a serous fluid, sometimes of a yellowish-green colour, like that of bile, with flakes of puromucus suspended in it, is discharged. On examination of the palpebral conjunctiva, it is found red and spongy; but the sclerotic conjunctiva may be as yet little injected.

In this way, first one eye, and in a day or two the other, becomes affected. That first affected generally suffers more in the course of the disease.

The swelling and redness, which were at first confined to the edges, by-and-by involve the whole eyelids, especially the upper. The palpebral conjunctiva becomes still more red, swollen, and velvety. The lacrymal caruncle and semilunar fold are red and enlarged, and the sclerotic conjunctiva is now more or less injected, even to the margin of the cornea.

As the disease approaches its height, the swelling of the eyelids increases, and their skin becomes of a brownish-red colour, tense, and shining. The upper eyelid, which is always the more swollen, overlaps the edge of the lower.

On separating the eyelids now, a quantity of thick yellow or green puriform or actually purulent matter escapes, and the conjunctiva of the palpebral sinuses, swollen and sarcomatous-looking from the engorgement of its vessels with blood, readily protrudes. Eversion of the eyelids, and protrusion of the conjunctiva of the palpebral sinuses, may take place even by the contraction of the muscles when the infant cries. The lacrymal caruncle and semilunar fold are very much enlarged, and the sclerotic conjunctiva is in the state of chemosis. In this stage of the inflammation, discharge of blood readily takes place from the conjunctival surface.

Hitherto the cornea may have continued unaffected, or at the most may have been hazy; but chemosis has usually not existed long, before it suffers more or less injury, becoming the seat of ulceration, abscess, or destructive purulent infiltration.

Constitutional symptoms—As the disease proceeds, the infant becomes fretful and uneasy, and does not suck or sleep. Its mouth is often aphthous.

Causes.—The infants, the subjects of this ophthalmia, are generally weakly, often twins, or prematurely born. Sometimes, however, they are strong and otherwise healthy.

Sometimes the disease can be attributed to no other exciting cause than such as gives rise to catarrhal ophthalmia. In many cases, exposure of the eyes to heat and light, or the direct intrusion of irritants, such as the soap or spirits used in washing the infant, appears to be the exciting cause. Inoculation with leucorrhœal matter from the vagina of the mother during parturition, there is reason to believe, a very common cause. Inoculation with gonorrhœal matter is, for obvious reasons, a less frequent cause. Dr. Cederschjöld, of Stockholm, found ophthalmia neonatorum occur in 20 out of 137, or 1 in 7 infants, the mothers of whom were affected with vaginal discharge; and in 10 out of 181, or 1 in 18, the mothers of whom were not so affected.

The disease may be propagated by infection *per contactum.* Adults having had the discharge from the infant's eyes accidentally applied to theirs, purulent ophthalmia has been produced, and that so severe as to destroy the eyes. In the inoculations which have of late years been practised for reproducing purulent ophthalmia, as a means of treating granular conjunctiva and pannus, it is the matter of ophthalmia neonatorum which has been used.

When there is a number of infants labouring under this disease collected together, as in lying-in and foundling hospitals, infection appears to be propagated *in distans.*

As several cases generally come under my notice at the same time, and as a considerable period often elapses before any new cases present themselves, I have been led to believe that there is something epidemic in the occurrence of this ophthalmia.

Diagnosis.—This disease is to be distinguished from a peculiar form of inflammation of the cornea, conjunctiva, and edges of the eyelids, met with in new-born infants affected with congenital syphilis, therefore also an *ophthalmia neonatorum*, though not a purulent conjunctivitis.

Prognosis and course.—In whatever stage of the disease the medical man be called in, he may in general pronounce a favourable prognosis, if he finds the cornea still clear, or even though hazy, still free from ulceration or abscess. If ulceration or abscess have taken place, the extent to which the cornea will be preserved clear, whether it may not be perforated and prolapsus iridis take place, and this whether to the extent of constituting the condition for the formation of partial staphyloma, can only be doubtfully prognosticated until a decided stop is put to the inflammation. The prognosis may then be regulated by the degree and extent to which the cornea has suffered (pp. 120, 121). If the cornea have become completely infiltrated with matter, it is destroyed; it will be thrown off by ulceration or sloughing, the iris will protrude, and the condition be laid for a total staphyloma.

Though the eye may have otherwise escaped, it may be left affected with central capsular cataract, strabismus, or incomplete amaurosis.

The disease yielding, the swelling of the eyelids diminishes. From being tense and shining red, the skin becomes wrinkled and pale livid. The chemosis and redness of the sclerotic conjunctiva subside; but although the swelling of the palpebral conjunctiva becomes much diminished, its redness and the enlarged state of its papillæ more slowly disappear. The puromucous or purulent discharge becomes less and less. All this, and the course to a cure, proceed rapidly if the cornea have remained unaffected; but the existence of ulceration, &c., of the cornea necessarily retards the cure of the other parts, which, in fact, proceeds only in proportion as the cornea heals.

Treatment.—The disease may be successfully treated from the first by such applications as nitrate of silver drops or ointment, or strong red precipitate ointment (pp. 83—85). These remedies must be applied by the surgeon himself once every second day. Before the application, the eye is to be cleansed from discharge, not by syringing, but in the following manner:—The surgeon first wipes away the discharge from the edges of the closed eyelids with a small piece of lint, about two inches square; then, opening the eyelids, he gently presses the matter out, and wipes it away with another piece of lint; and so on, until no more matter presents itself.

The nurse, having been taught how to wipe the discharge away first, should use the alum, or bichloride of mercury collyrium tepid, three times a day, for bathing and cleansing the eye, allowing it to run in as freely as possible. When the infant is put to sleep, the edges of the eyelids are to be anointed with the weak red or white precipitate ointment, to prevent them from being glued together.

When the conjunctiva of the eyelids and sinuses is already swollen, sarcomatous looking and gorged with blood, as it generally is before the case comes under the care of the surgeon, it is necessary to scarify it immediately before applying the strong drops or ointment. The way of doing so is this :—The infant being laid by the nurse across her lap, and the head made to rest on the surgeon's knee, he cleanses away the matter with pieces of lint, as above directed, and then having everted the upper eyelid, scarifies the protruding conjunctiva. The blood, which flows freely, he takes up with pieces of lint, which he throws away as fast as they get soaked with blood. The conjunctiva of the lower lid is next scarified in the same manner. The bleeding having ceased, the strong red precipitate ointment is put in between the eyelids, so that it may come into contact with the whole conjunctival surface. This scarification of the palpebral conjunctiva and application of the red precipitate ointment it may be necessary to repeat several times in the course of the disease, but only at intervals of two or three days.

Whenever the eyelids become everted, they should be immediately restored to their proper position, which is done by seizing the eyelid between the finger and thumb, drawing it a little from the eyeball, and then turning it down. Should the eversion have been allowed to continue some time, and the eyelid cannot be restored to its proper position, the everted conjunctiva is to be scarified; and when it has thus been somewhat emptied of blood, it will admit of being returned more readily. If there is reason to fear that the eyeball is much pressed on, it would be advisable to slit up the eyelid at its outer corner before returning it.

Cleansing of the eyes with the alum or bichloride lotion three times a day, and thereafter the application of the weak red precipitate ointment to the edges of the eyelids are to be continued. If there should be ulceration of the cornea threatening to penetrate, belladonna or atropia lotion will be found the best application for use by the nurse.

Counter-irritation by means of small blisters, or by painting with the strong tincture of iodine behind the ear promotes the action of the preceding treatment, after the inflammation and swelling have begun to subside.

Internally, a grain or two of grey powder, a little castor-oil, or rhubarb and magnesia, is to be given as occasion requires; and when the cornea is threatened, small doses of calomel and quina, gr. $\frac{1}{4}$ of the former, and gr. ss. of the latter, rubbed up with sugar, twice a day.

The diet of the nurse is to be carefully regulated. During the height of the disease it may be advisable for her to abstain from animal food and strong drinks; but as it declines she may take, besides animal food and wine or porter, tincture of iron.

When the discharge has ceased, but the conjunctiva continues red and relaxed, the four grain solution of nitrate of silver, or the lapis divinus solution (p. 83), may require to be dropped into the eyes at intervals of two or three days, for several times successively. Calomel dusted into the eyes is also a good application (p. 86).

Prevention.—The purulent ophthalmia of infants is the cause of the blindness in a large proportion of the blind poor.

The manner in which this disease is neglected, among the poorer classes especially, is almost incredible, notwithstanding the needful advice and medicines may be had for the asking. It is usually only after the disease has been going on for two or three weeks, and when the eyes have already, perhaps, been irremediably injured, that the surgeon is applied to. In excuse for this neglect, we are often told, by the mother or nurse, that the complaint of the eyes was supposed to be *nothing more than a cold;* as if a cold in the eyes might not, and did not, in many cases, prove very destructive to vision. The truth is, that, in numerous instances, a cold has some share at least in the production of this ophthalmia of new-born infants.

To guard against the disease as far as possible, the eyes of infants, immediately after birth, should be gently bathed with simple warm water, by means of a bit of soft linen rag, and afterwards carefully dried. The greatest attention should always be paid to protect the eyes from exposure to light, heat, and draughts of air. At the same time, it must be remembered that the air ought not to be confined around the infant's face. Of course, good ventilation of the apartment is essential.

As soon as symptoms of the disease are discovered, medical assistance ought to be called in. Every hour's delay is fraught with the most imminent danger to the sight.

Even when the eyes are not materially injured, or totally destroyed by the ophthalmia of new-born infants, they are liable to be left in a much debilitated state and very susceptible of future disease.

8th.—*Congenito-syphilitic ophthalmia neonatorum.*

In congenitally syphilitic infants, we sometimes meet with an inflammation of the eyes, different in its characters from ordinary purulent ophthalmia neonatorum, though liable to be confounded with it. It is not a purulent conjunctivitis like it.

The cornea is dim. The ocular conjunctiva has a greyish, dry, cuticular appearance, and is but little vascular. The palpebral conjunctiva is sometimes invested with a pseudo-membraneous exudation.

The edges of the eyelids are red and ulcerated.

In many cases, we find that the infant is not suckled, either in consequence of the mother having no milk, or in consequence of the infant having been delegated to the care of a nurse, to be brought up by hand.

Such infants are cachectic, and usually sink under the influence of the general disease.

Treatment.—This must be chiefly of a general nature. As a local application, the bichloride of mercury lotion may be used.

9th.—*Pseudo-membraneous and diphtheritic ophthalmia.*

Cases of puromucous or purulent ophthalmia are sometimes met with in which, at an early stage of the inflammation, the surface of the palpebral conjunctiva, swollen, tense, and shining, is found coated with a pseudo-membraneous exudation of a greyish or yellowish-white aspect. This is gradually thrown off, and the case comes to present the ordinary characters of a puromucous ophthalmia.

The false membrane has been found on examination to be formed of coagulated fibrine containing pus corpuscles in its meshes.

Under the name of *Diphtheritic Ophthalmia*, attention has of late years, especially in Germany, been called to an inflammation of the conjunctiva characterized by fibrinous exudation not only *on* the surface, but also *in* the interstices of the membrane.

A diphtheritic epidemic constitution of the atmosphere is said to be the chief cause which determines this exudation on the surface and in the substance of the conjunctiva,—in other words, which determines the morbid condition of the blood on which the diphtheritic exudation depends,—any ophthalmia, it is said, being liable, under the influence of that atmospherical constitution, to put on the diphtheritic character.

Objective symptoms.—The eyelids are moderately swollen, but peculiarly hard from fibrinous exudation in their substance. The palpebral conjunctiva—and, in exceptional cases, the ocular also—is infiltrated with fibrinous exudation as well as covered with false membrane. This, which is of greater or less thickness and extending sometimes even to the free border of the eyelid, is intimately adherent, in consequence, apparently, of its being continuous with the similar exudation in the interstices of the conjunctiva. The false membrane is, therefore, not easily detached, and, when it is so, the conjunctiva at the place bleeds.

Underneath, the conjunctival surface is smooth, glistening, and marbled with points of extravasation.

The ocular conjunctiva, greyish and bloodless-looking, is raised up around the cornea in the form of chemosis (*white chemosis*).

What discharge from the eye there is, consists of a dirty-grey serum, containing flakes of detached fibrine.

Whilst the above phenomena are passing in the conjunctiva, the cornea rapidly becomes infiltrated, ulcerated, and perhaps destroyed, as in severe cases of purulent ophthalmia, in consequence of the pressure to which it is subjected by the chemosed conjunctiva and swollen eyelids.

Eventually the discharge assumes more the character of that of purulent ophthalmia, and the false membrane is thrown off.

Subjective symptoms.—At the outset of the disease, there is usually severe pain accompanied by heat, with feverish disturbance of the system,—and perhaps diphtheritic exudation on other mucous membranes. In a later stage, when the cornea is suffering, there is in addition a marked state of depression.

Difference between pseudo-membraneous and diphtheritic ophthalmia.—In the first form, the false membrane may be thick, opaque white, but often flocculent and easy of being detached. In the second, it is more organised, greyish, never flocculent, and very adherent. In the first form, the conjunctiva is red, spongy, and very vascular. In the second, it is of a pale or yellowish-grey, little vascular, rather smooth and even, than granular; its tumefaction is not owing to sanguineous congestion, but to fibrinous infiltration—hence, the eyelids have also a characteristic hardness. Lastly, in the first form there is a discharge, citron-coloured at first, and afterwards quite purulent. In the second form, the eye is dry at first, and only afterwards gives issue to a dirty-grey liquid, with fibrinous flakes in it. In one word, whilst in the first form the injection of the conjunctiva and the purulent discharge are the principal facts, and the pseudo-membraneous exudation, the accessory fact;—in the second form, it is the fibrinous infiltration of the conjunctiva and the absence of vascularity which are the characteristic phenomena.

The first form is only a purulent ophthalmia complicated with pseudo-membrane,—the second merits the name of ocular diphtheritis.

Cause of diphtheritic ophthalmia.—This malady is developed under an epidemic form, as above mentioned, and is also essentially contagious. The occurrence of the disease at the Hôpital des Enfants, Dr. Foucher* found coincided with the prevalence of croup in the establishment.

When diphtheria, croup, and puerperal fever prevail, diphtheritic ophthalmia is said to prevail also.†

Diagnosis of diphtheritic, from acute catarrhal and purulent ophthalmia.—In acute catarrhal ophthalmia, the eyelids are not very much swollen. The palpebral conjunctiva is of a deep red, and velvety-looking. The ocular is also red. The cornea has no tendency to ulcerate. The discharge is a colourless or yellowish serum mingled with mucous or muco-purulent flakes.

In purulent ophthalmia, the redness of the skin and tumefaction of the eyelids are very great, as is also the chemosis around the cornea. The palpebral conjunctiva is very red, granular, and swollen. The cornea has a great tendency to be destroyed by ulceration. The discharge, at first serum mixed with flakes of puro-mucus, soon becomes thick and purulent.

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* The account of diphtheritic ophthalmia here given is taken chiefly from Dr. Foucher's French edition of the present work.

† It is to be presumed that the phlebitic ophthalmitis which has been met with in women labouring under puerperal fever, is not here referred to. Considering the grave nature of the primary disease, the affection of the eye in such cases constitutes but a very secondary consideration.

In diphtheritic ophthalmia, the conjunctiva, hard and resisting from fibrinous infiltration, is invested with a thick pseudo-membrane. There is white chemosis around the cornea. The eyelids are swollen, hard, and stiff, of a pale livid colour, except towards the free border, where there is some redness. The pain and the heat are intense. The discharge, when established, consists of a dirty-grey serum containing yellowish flakes.

These characters are found thus combined only at the period of the developed state of the ophthalmiæ in question. At first it is always difficult to distinguish the different cases.*

Prognosis.—Diphtheritic ophthalmia is rapid in its course, and quickly leads to destruction of the cornea and the whole eye.

Treatment.—Never having seen a specific case of diphtheritic ophthalmia, I cannot speak of its treatment from experience. Suppose, however, that a case such as is above described came under my notice, I should at once have recourse to incision of the chemosed conjunctiva to relieve the cornea from pressure. Warm water or belladonna lotion would be the only local application I would use at first, but when the disease came to present more the characters of purulent ophthalmia, irritating drops, ointments, and lotions would be proper.

Internally, small doses of calomel frequently repeated to affect the system would be necessary, with or without tonics, according to circumstances.

10th.—*Erysipelatous ophthalmia.*†

The conjunctiva is always more or less affected in erysipelas of the eyelids, but idiopathic erysipelatous ophthalmia is not of unfrequent occurrence.

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* It is to be remembered that in ophthalmitis—phlebitic, exanthematous, traumatic, &c.—lymph is exuded *in* as well as *on* the conjunctiva, which is raised up around the cornea in the form of white chemosis.

† Conjunctivitis erysipelatosa idiopathica.

Objective symptoms.—To the anatomical description of erysipelatous inflammation of the conjunctiva above given, it only remains to add under this head, that the eyelids and cheek are œdematous, that in consequence of the gravitation of the fluid or pressure of the upper eyelid, the serous chemosis is greater below than above—that the cornea appears half buried by it—that there is some puro-mucous secretion with occasional lacrymation and increased Meibomian discharge. The protruding conjunctiva is liable to be abraded or become dry by exposure to the air.

In some cases, I have found this ophthalmia and stye co-existing.

Subjective symptoms.—The patient complains of an uneasy sensation of pressure and tension about the eye when it is moved, with itching and smarting at the edges or corners of the eyelids, especially when a stye is forming, and some impatience of light.

Constitutional symptoms.—The subjects of this ophthalmia are most commonly persons of weakly constitution, advanced in life, or labouring under gastric derangement: but these conditions are to be viewed rather as the predisposing causes than as the symptoms of the ophthalmia.

Causes.—The *predisposing causes* have been just referred to.—*Exciting causes.*—Exposure to cold and wet. Injuries, chemical or mechanical, of the conjunctiva; it sometimes occurs after needle operations for cataract. In an old man affected with small irritable ulcers on his legs, with surrounding erythema, I once saw it occur as if by metastasis on the application of warm fomentations to the legs.

Diagnosis.—The nature of the conjunctival inflammation is at once perceived; but in forming the diagnosis, it should be determined whether there be any complication —such as sclerotitis.

Prognosis and course.—The prognosis is good. The disease usually begins to subside in a few days—the watery effusion is gradually absorbed—and the conjunctiva becomes again applied to the sclerotica, but continues for some time in a loose flaccid state. During this process, the injection of the conjunctiva disappears, but the spots of extravasated blood are some time of being absorbed. The lacrymal, Meibomian, and conjunctival secretions return to their natural quantity and quality.

Treatment.—Three grains of mercurial chalk, with watery extract of aloes, and extract of hyosciamus, of each one grain at bed-time, followed by a purgative draught in the morning; and as a collyrium, the solution of the bichloride of mercury, with vinum opii (p. 81), will in general suffice to check the disease. Good diet, cordials, and tonics, may be afterwards given.

Instead of a lotion, some prefer dry warmth, by means of medicated bags (p. 77), hung over the eye. If more agreeable to the patient, this may be adopted; but in either case it will be necessary afterwards to drop in vinum opii to give tone to the relaxed membrane.

Genus II.—SCLEROTITIS.

The species of this genus admitted, are rheumatic ophthalmia, and sclerotitis with inflammation of the tendinous insertion of the recti muscles.

1st.—*Rheumatic Ophthalmia.**

In rheumatic ophthalmia, the sclerotica is the principal seat of the vascular congestion; but, as above shown (p. 110), there is usually some degree of implication of the cornea and iris in the inflammation, the former from exudation, the latter from both congestion and exudation. Rheumatic ophthalmia, considered as a pure sclerotitis, or a sclerotitis with the slight complications mentioned, is of rare occurrence, in consequence of its tendency to merge into corneitis, catarrho-rheumatic ophthalmia, aquo-capsulitis, or decided iritis.

Objective symptoms—Redness.—At the commencement, the principal redness is from the sclerotic injection, the characters of which have been above described. By-and-by there is added some injection of the conjunctiva, especially of its circumcorneal zone.

State of the cornea.—The cornea becomes dim from exudation into it; and over its margin, at some side, or even all round, vessels may be seen shooting to the extent of one-twentieth or one-tenth of an inch, and then suddenly stopping.

State of the iris.—The iris becomes discoloured, the pupil contracted, sluggish in its motions, and perhaps hazy from slight exudation.

There is lacrymation, but no increased conjunctival, nor Meibomian secretion.

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* Sclerotitis rheumatica vel idiopathica.

Subjective symptoms.—The most striking subjective symptom is the rheumatic pain around the orbit, in the temples, face, &c., becoming exacerbated at night when the patient gets warm in bed, and remitting only towards morning. Besides this rheumatic pain, there is deep-seated, distending, and pulsative pain of the eyeball.

There is intolerance of light accompanying the lacrymation, usually in proportion to the degree of implication of the cornea and iris.

The vision is dim in proportion to the dimness of the cornea and haziness of the pupil.

Constitutional symptoms.—Resembling rheumatism in accompanying pain and its exacerbations, this disease resembles it also in the constitutional symptoms, inflammatory fever, derangement of digestive organs, &c.

Causes.—This disease likewise resembles rheumatism in respect of its causes, predisposing as well as exciting; but the subjects of it, who are always adults, may never have suffered from rheumatism in any other part of the body.

Both eyes are seldom affected together. When they are so, one is much less severely affected than the other.

Diagnosis.—Rheumatic is readily distinguished from catarrhal ophthalmia by the seat and character of the vascular injection (pp. 19, 109), by the absence of any mucous secretion from the conjunctiva in the former, and especially by the difference in the character of the pain. Catarrho-rheumatic ophthalmia is attended by all the symptoms of rheumatic ophthalmia, with the superaddition of those of catarrhal, and a greater tendency to mischief in the cornea than in either. From aquocapsulitis or iritis, rheumatic ophthalmia is distinguished by the slight degree, if not absence of affection of the membrane of the aqueous humour or iris.

Prognosis.—This ophthalmia may prove slight and soon go off, but even when not so slight, the prognosis is in general good. The degree to which the cornea or iris may have become affected, however, will of course modify the prognosis. A person having once suffered from it is very liable to renewed attacks. Sometimes it occurs in a chronic state, and proves obstinate without being severe.

Treatment.—The treatment is to be commenced with a dose composed of calomel, gr. ij., extract of colchicum, gr. j., and Dover's powder, gr. x., at bed-time, followed by a purgative draught in the morning.

After that a pill of calomel and Dover's powder (gr. j.—gr. ij ß), three times a day, until the gums are just touched. If the bowels become confined, a solution of Epsom salts, ℥ß. in water, ℥viij., with wine of colchicum ʒij., in doses of two table-spoonfuls in the morning may be prescribed.

The eye is to be bathed occasionally with belladonna or atropia lotion, tepid, and in the intervals kept lightly covered with a dry compress. As a means, though only subsidiary, of moderating the rheumatic pain around the orbit, or in the temples, &c., friction over the seat of pain with mercurial ointment, combined with an equal part of extract of belladonna; with a tincture of tobacco (p. 78); or with morphia dissolved in almond oil, may be employed at bed-time.

If, by this medication, the disease is not checked, and especially if the rheumatic pain is severe, and the cornea and iris threatened, it may be found necessary to abstract blood by leeches, or even venesection, to the extent of ℥x. or ℥xij., according to the strength of the patient.

Counter-irritation, by blisters behind and below the mastoid process or to the nape of the neck, is useful in the decline of the inflammation.

When by the above treatment the disease has been checked, tonics promote convalescence. Bark and carbonate of soda, in doses of five to ten grains each, two or three times a day, is a favourite tonic; quina also is useful.

2nd.—*Inflammation of the sclerotica, and tendinous insertion of the recti muscles.*

The anatomical characters of this ophthalmia have been above sketched (p. 110).

The inflammation is most commonly confined to the insertion of the external rectus;—sometimes, it presents itself at the insertion of the internal rectus also;—rarely is it found implicating the insertion of all the four recti.

In illustration of its course and treatment, the following cases are given:—

In a lady between thirty and forty, in whom the inflammation affected the insertion of the external rectus of the left eye, and had already existed for five months, I found close to the cornea a yellowish-grey elevated patch under the conjunctiva. Along with some conjunctival, there was considerable sclerotic injection at the place, encroaching on the cornea, which had become dim to a great extent in its outer half. There was also some pink sclerotic injection all round the cornea, though no decided implication of the insertions of the other recti muscles.

There had been considerable supra-orbital pain.

This case had been treated with iron and quinine internally, counter-irritation, and drops of vinum opii and nitrate of silver externally, without benefit.

The treatment which I have found most effectual in such cases is calomel in half-grain doses, with a grain and a half of Dover's powder, three times a day, persevered in for some time,—often some weeks. Occasionally two or three leeches are required.

Belladonna or atropia lotion, or simple tepid water, is the only admissible application at first. When the congestion and thickening begin to subside, tonics may be given with effect; and the bichloride of mercury with vinum opii lotion used.

A girl, aged 8, of scrofulous constitution, has had the eyes slightly blood-shot for a month past—the right more affected than the left. On examination, there is seen in the right eye, on the nasal and temporal sides of the cornea, a broad yellowish-grey elevation depending chiefly on thickening of the sclerotica and tendinous insertions; there is sclerotic and also slight conjunctival injection at the place. No pain, nor intolerance of light. Sight quite good.

After three or four two-grain doses of hydrargyrum cum creta, at bed-time, the eyes were found better,—the redness much diminished; but improvement not advancing, two leeches were twice applied at an interval of six days; each time with benefit. Cod-liver oil was then given, and after that the vascular injection and thickening of the sclerotica progressively diminished, until, about the end of two months, the eyes were quite well and the sclerotica of its natural appearance.

In the case just related, there was no pain, and the cornea remained quite clear; but in another case, the patient, a girl of twelve or thirteen, complained of some pain, especially over the eyebrows, and the cornea became somewhat nebulous. In this second girl, in whom the inflammation was altogether more severe, recovery took place under similar treatment, but more slowly.

This inflammation must not be confounded with pustular ophthalmia, on the one hand, nor with sclerotico-choroiditis on the other.

Sclerotico-kyklitis and sclerotico-choroiditis.

These inflammations involving the sclerotica will be considered below, the one under *anterior internal*, and the other under *posterior internal ophthalmia.*

Genus III.—CORNEITIS.*

Whilst congestion was taken as the characteristic of rheumatic ophthalmia, considered as a sclerotitis, exudation, for the reasons above given (p. 111, et seq.), must be taken as the characteristic of corneitis.

As species of corneitis, I rank, 1st, common scrofulous or phlyctenular ophthalmia, 2nd, parenchymatous corneitis, hitherto designated scrofulous, but now generally recognised as congenito-syphilitic in its origin, and 3rd, rheumatic corneitis.

Scrofulous or phlyctenular ophthalmia is usually ranked as a conjunctival inflammation, but with no good reason, seeing that although the conjunctiva is the seat of injection, the redness is neither great nor uniform, the vessels being few in number, and running singly or in detached fasciculi towards the cornea—an injection of the conjunctiva which is the consequence rather of the afflux of blood towards the primarily affected cornea; and seeing that it is the cornea which is the seat of the exudation—of phlyctenulæ, of ulcers, and of new vessels into which those of the conjunctiva are continued. Moreover, besides conjunctival, there is some degree of sclerotic, injection.

Corneitis, commonly so called, comprising both congenito-syphilitic, and rheumatic corneitis, is an inflammation of the "adhesive" character, involving principally the proper substance of the cornea; hence it has been also named *parenchymatous* corneitis, though the conjunctiva corneæ, on the one hand, and the membrane of Descemet, on the other, may also become affected.

While in phlyctenular ophthalmia and corneitis, commonly so called, the iris is apt to become involved, it is always more or less so in inflammation of the membrane of Descemet. Indeed, affection of the iris constitutes a part of this ophthalmia, which has thence been named *kerato-iritis*, and also *aquo-capsulitis*, under the impression that the membrane of Descemet extends over the anterior surface of the iris, and thus constitutes the investing membrane of the anterior chamber of the aqueous humour. The inflammation in question will thus be best treated of under the head of *ophthalmia interna anterior*.

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* Keratitis.

The other ophthalmiæ, in which the cornea, whether its proper substance, or its conjunctival layer, is implicated, belong to the genus of compound external ophthalmia (p. 203).

Cases of inflammation of the sclerotica and tendinous insertion of the recti muscle in which the cornea becomes much affected might be viewed as coming under the head of corneitis (p. 187).

1st.—*Scrofulous, or phlyctenular ophthalmia.*[*]

This is the most common form of ophthalmia in children of from one to twelve years of age. Out of 100 cases of ophthalmia at that time of life, it has been estimated that 90 are cases of this kind. Although the subjects of it often present the scrofulous diathesis in a well-marked manner, and not unfrequently are labouring at the same time under scrofulous affections of other parts, it is to be remembered that cases frequently occur in which there are no such evidences of scrofula. Unless, therefore, we choose to view, as some do, this form of ophthalmia itself as a manifestation of a scrofulous constitution, the term "scrofulous ophthalmia" must be received rather in a conventional than in a literal sense.

Objective symptoms.—When the little patient is brought into the light to be examined, the eyelids are found spasmodically closed, the eyebrows depressed, and the cheeks drawn up, the child endeavouring at the same time to cover the eyes with his hands in order to protect them from the light.

In consequence of the very forced closure of the eyelids, their borders are sometimes found so much inverted, that their cutaneous surfaces are in contact; and if this has been of long continuance, these surfaces will be moist and soft like mucous membrane.

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[*] Conjunctivitis scrofulosa vel strumosa—Erethitic form of scrofulous ophthalmia.

There is greater or less redness and excoriation of the cheeks, and not unfrequently an impetigenous eruption, extending over the face, forehead, and temples.

As it is in general impossible for the child to open the eyelids, even if disposed, in consequence of the great intolerance of light and involuntary spasmodic closure of the eyelids, it is necessary for the surgeon to do so in order to examine the eyes. For the mode of procedure, see p. 17.

On opening the eyelids, which are probably somewhat red and tumid at their margins, a gush of hot tears takes place, which had been pent up in the oculo-palpebral space in consequence of the continued closure of the eyelids.

The examination will probably not disclose much vascular injection of the sclerotic conjunctiva, and some of what is seen, even, may have been caused by the irritation of opening the eyelids. There may be merely a fine circumcorneal reticular blush, fed by some small pink scattered vessels running towards it, such as is occasioned by the irritation of a foreign particle which has got into the eye. Some larger vessels, however, will perhaps be seen running, in fasciculi, from the angles towards the cornea. In addition to the conjunctival injection, there is also circumcorneal zonular redness of the sclerotica.

The palpebral conjunctiva is usually the seat of considerable congestion.

The cornea, though suffused, may be as yet free from any circumscribed speck; but ere long, one or more *phlyctenulæ* are met with, or small ulcers left by the bursting of phlyctenulæ.

The cornea may be still unpervaded by red vessels; or perhaps a single one may be detected running over its margin towards the phlyctenula; or if instead of a phlyctenula, an ulcer already exists, there may or may not be a fasciculus of vessels extending into it (p. 115). Plate I., fig. 3.

Sometimes there is onyx, sometimes an abscess or large pustule.

The pupil is usually rather contracted.

Whilst the lacrymation is so great, the conjunctival and Meibomian secretions are not much increased.

Both eyes are generally affected at the same time, but one is always worse than the other.

Subjective symptoms.—There is in general not much distress, except from the great intolerance of light; and this remits towards evening, or may be relieved at other times by darkening the room. There occur, however, occasional attacks of darting pain in the eye at night; and if phlyctenulæ or ulcers exist, there is the painful sensation as if a foreign body were in the eye, aggravated when the eyelids are moved. The irritation of the excoriated cheek by the tears also causes considerable distress.

Constitution and state of health.—As above mentioned, the constitution of the subjects of this ophthalmia is in a great number of cases that which is known by the name of scrofulous.

Along with the ophthalmia, a disordered state of the health will be found generally to exist. The digestive organs and skin especially will probably be found out of order, with feverishness and irritability of temper.

Causes.—The predisposing causes of scrofulous ophthalmia may be referred principally to the age, constitution, and state of health of the patient. That age predisposes, is shown by the circumstance, that it is the most common by far of all the inflammations of the eye in children, and that an inflammation originally of a different kind, in childhood, is extremely apt to run into it. That the constitution predisposes, may be inferred from the name of the disease being taken from that state of constitution in connexion with which the ophthalmia so frequently manifests itself in early life. It is to be observed, that at such age, and in such constitutions, it may in one case be the eye, in another the ear, in a third some other organ which is affected; but in all, the digestive organs are found more or less at fault. Previous attacks, and also exanthematous diseases, predispose to it.—See *Exanthematous ophthalmiæ.*

Exciting causes.—This inflammation may be excited by any of the ordinary exciting causes of ophthalmic inflammation, the age, constitution, and state of health determining its particular character. Any common inflammation of the eye is in such circumstances apt to merge into this. The ophthalmia often appears to be excited and kept up by the irritation of teething.

Diagnosis.—The symptoms of this ophthalmia are so very striking, that it can scarcely be confounded with any other, especially if the age of the patient be taken into account.

In so far as regards the slight degree of redness of the white of the eye and the great intolerance of light, parenchymatous corneitis resembles it; but the changes which take place in the cornea in the two ophthalmiæ are quite different. In parenchymatous corneitis, there is no formation of phlyctenulæ, nor ulceration, and rarely onyx or abscess, but opaque adhesive exudation into the substance of the cornea, and development of a general deep-seated vascularity, with increased prominence of the cornea.

Scrofulo-catarrhal ophthalmia is distinguished from phlyctenular ophthalmia by the greater redness of the white of the eye, and the less degree or absence of intolerance of light. Cases, however, occur, and they are usually of the most stubborn character, in which with excessive intolerance of light there are the objective symptoms of scrofulo-catarrhal ophthalmia, viz., redness and swelling of the eyelids, increased Meibomian secretion, great congestion of the conjunctiva, and puro-mucous discharge.

The age of the patient alone, independently of other points of difference, distinguishes between this ophthalmia and catarrho-rheumatic.

Course and prognosis.—Phlyctenulæ on the cornea may either recede without being matured, or pass into ulceration. If a phlyctenula on the cornea recede, it will leave a speck called *albugo*—round, smooth, slightly elevated, and densely opaque in its centre, but shaded off at its circumference. Sometimes a vessel or two may be seen running into an albugo, or a nebulous streak indicates where vessels had run.

If ulceration has taken place, the ulcer will probably be the point of termination of a fasciculus of vessels as above mentioned (p. 191); but when the healing process commences, one vessel after another shrinks and disappears. If the ulcer has penetrated to any depth, an opaque cicatrice or *leucoma* will be left (p. 119).

There is a circumscribed and rather deep ulcer of the cornea met with in this disease. It is circular, with smooth, round edges, quite clear to its bottom, unaccompanied by any extension of vessels into it, and the cornea around is scarcely, if at all, nebulous. The cornea looks simply as if a small piece had been scooped out of it. After this ulcer heals, a small clear facet remains (p. 119).

The inflammation continuing unchecked, ulcers which may have formed, often go on increasing in depth, until the proper substance of the cornea is perforated, in which case the membrane of Descemet is protruded through the opening at the bottom of the ulcer in the form of a small transparent vesicle (*hernia of the cornea*), which soon bursts, and the aqueous humour escapes, the consequences of which have been described above (p. 117, et seq.)

Iritis sometimes supervenes on this form of ophthalmia. Sometimes, also, inflammation of the posterior tunics, by which the eye is left amaurotic, atrophic, or in a state of varicosity.

From long continuance of the forced closure of the eyelids (p. 191), entropium is apt to be induced. Occasionally, a fasciculus of the eyelashes of the upper eyelid is found turned in under the lower eyelid at the outer corner. (See p. 9.)

There is less tendency to ophthalmia tarsi in this, than in scrofulo-catarrhal ophthalmia.

This is one of the most obstinate of all the acute inflammations of the eye, and one of those most liable to relapse. The disposition to the disease, however, diminishes on the approach of puberty.

If the cornea be still free from phlyctenulæ or ulcers, the prognosis is good; but if phlyctenulæ or ulcers exist, the prognosis must be qualified by the likelihood of a speck or specks on the cornea. See above.

The state of the constitution, and the circumstances in which the patient is placed, must greatly influence the prognosis.

The dismissal, when cured, should always be accompanied by a warning as to the great tendency of the disease to return, and instructions as to the diet and regimen best calculated to guard against a relapse.

Treatment.—The treatment is always advantageously commenced with an emetic—and an antimonial emetic is the best. (Vin. antimon. ʒj., aq. pur. ℥ij.—a table-spoonful every ten minutes until vomiting.)

After this small doses of hydrargyrum cum creta (gr. ij.). in combination with powdered leaves of belladonna (gr. ſs.—j.) are to be given night and morning for a few days. A dose of calomel and rhubarb or scammony may, occasionally, be required in addition.

The digestive organs having been by the alteratives and purgatives brought into a better state, the disulphate of quina, in doses of gr. j.—ij., three times a day, will be found, in a large proportion of cases, to act like a specific. Under its use, the inflammation and intolerance of light soon begin to subside, and this is followed by the disappearance of the phlyctenulæ and healing of the ulcers on the cornea.

Cod-liver oil with or without quina is often of great efficacy. In some cases, iron, or sulphuric acid, and in others, rhubarb with carbonate of soda, will be found useful as tonics.

In the third American edition of the present work, the Editor, Dr. Atlee, says that he has used arsenic with good effect in many cases of this disease, more especially those complicated with chronic eruptions of the skin. The following is the formula which he gives:—℞ Vini Ferri,—Syrupi simplicis, āā ℥ß.—Liquoris arsenicalis, ♏xxxij.—Aq. anethi, ℥j. *Sig.* One tea-spoonful at meals, three times a day.

The application of two or three leeches around the eye is occasionally required to relieve the congestion, and thus to promote the action of the other remedies. In a case, for example, attended with great intolerance of light, little or no impression was made on the inflammation by the ordinary remedies for a month, until after the application of two leeches to each eye, when the inflammation and intolerance of light began to diminish; and under the use of remedies which before proved ineffectual the case went on to a cure.

A warm bath at bed-time is useful, relieving feverishness and determining to the skin.

As an application to the eye itself, the belladonna or atropia lotion may be used from the first. It soothes the eye, and greatly, if not wholly, relieves the intolerance of light. Steaming the eyes with the vapour of hot water impregnated with belladonna, has the same effect (p. 77).

The acute symptoms having been overcome by the treatment above indicated, recourse may be had to the use of the bichloride of mercury lotion three times daily, and the weak red precipitate ointment at bed-time; whilst at intervals of two or three days the nitrate of silver solution may be dropped into the eyes (gr. iv.—℥j.).

Counter-irritation by blisters, kept open or repeatedly renewed, behind and below the mastoid process, is always of great service, when the ophthalmia has begun to decline. A warm plaister between the shoulders may be afterwards worn. Even before the ophthalmia has begun to decline, it is often useful to pencil with the solid nitrate of silver the skin of the eyelids, in those cases especially, above mentioned (p. 191), in which the skin is moist and soft. In other cases pencilling of the skin of the eyelids with strong tincture of iodine often does great service.

If under this treatment the case does not improve, but the inflammation, on the contrary, continues active and severe, the iris perhaps becoming discoloured, with the pupil contracted, and ulceration threatening to penetrate the cornea, the following treatment should, without delay, be had recourse to:—Two or three leeches to the eye, half-grain doses of calomel three times a day, in conjunction with the quina; and the resumption of the belladonna or atropia fomentation, to keep the pupil dilated if it is the centre of the cornea which is the seat of ulceration, in order, if penetration should take place, prolapsus iridis may be obviated; but if, on the contrary, the ulceration be towards the circumference, fomentations of warm water alone are to be used.

But in a case in which penetration of the cornea by ulceration is threatened, it is better to put the patient at once under the influence of chloroform, and evacuate the aqueous humour by the operation of *paracentesis corneæ* (p. 149).

Where penetration of the cornea has actually taken place, and the aqueous humour in consequence evacuated and the iris fallen forward against the cornea, the patient must be kept very quiet. The inflammation now remitting, the ulcer of the cornea closes, the aqueous humour reaccumulates, and the iris resumes its natural position if no prolapse has occurred. Under these circumstances the calomel is to be omitted, and the cod-liver oil and quina resumed. The irritating collyria to the eye will now promote the subsidence of the inflammation and the cicatrization of the ulcer.

In the cases above mentioned, in which, with excessive intolerance of light there are the objective symptoms of scrofulo-catarrhal ophthalmia, I have found scarification of the palpebral conjunctiva, and, immediately thereafter, the application of the strong red precipitate ointment, of the greatest service. The scarification, which evacuates a great quantity of blood, and the application of the ointment, may be repeated at intervals of two or three days.

The eyes are not to be bound up, but may be protected by a large shade, like a bonnet front.

Good air, moderate light, friction of the skin, particularly with a towel dipped in a strong solution of salt, and dried, as recommended in the American edition of this work, the tepid bath, comfortable clothing, and simple nourishing diet, are important dietetical adjuvants in the treatment of this ophthalmia.

When there is great tendency to relapse, removal to a milder climate or a more sheltered situation, will often be advantageous.

2nd.—*Parenchymatous corneitis.**

There are two distinct forms of this disease, designated acute or erethitic, and chronic or torpid.

Acute or erethitic form.

Objective symptoms.—There is little redness of the white of the eye, and what does exist is principally due to sclerotic injection. The proper substance of the cornea is the seat of exudation. This is manifested by a deep-seated greyish-white opacity, denser at some points than others, which by-and-by becomes intermixed with red, in consequence of the development of vessels in the exuded matter. In this case, the cornea presents a peculiar opalescent appearance.

When the conjunctiva corneæ is co-affected, as is often more or less the case, it is in some part of its extent opaque, thickened, and vascular, the vessels being in continuation with those of the corresponding part of the circumcorneal network of the sclerotic conjunctiva, the injection of which part is greater than elsewhere. In the rest of its extent, the surface of the cornea may become rough and dim, like ground glass, though this is an appearance more characteristic of the chronic or torpid form of the disease.

In the course of the disease, increased prominence of the cornea is apt to take place, owing to softening of its texture, on the one hand, and distension by increased accumulation of aqueous humour on the other.

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* **Keratitis parenchymatosa.**

Iritis may supervene, but this, on account of the opacity of the cornea, may not be readily detected.

Subjective symptoms.—There is perhaps headache, but, in general, little pain in the eyeball—an uneasy feeling merely of distension or of pressure over it—the intolerance of light is more or less considerable, and as usual, accompanied by lacrymation. Of course, there is dimness of vision, in proportion to the opacity of the cornea.

Both eyes are usually affected, first one, and after a while the other.

Constitutional symptoms.—When the local symptoms are most severe, so are the constitutional, viz. general feverishness, dry skin, white tongue, loss of appetite, and headache.

Exacerbations and remissions of the disease occur.

Predisposing causes.—The subjects of the disease are generally from eight to eighteen, and of a scrofulous diathesis. Females are more frequently affected than males, and in them, when of the age of puberty, there is often disturbed menstruation. By his researches into the history of numerous cases of this disease, Mr. Jonathan Hutchinson has satisfactorily established the fact, that a hereditary syphilitic taint constitutes almost always the root of the disease. Amongst other peculiarities of physiognomy which persons subject to this form of corneitis present, indicative of the constitutional taint, may be mentioned cicatrices of old fissures at the angles of the mouth, and especially ill-developed and vertically notched upper incisor permanent teeth—Fig. 38. On inquiry, it will usually be found that brothers and sisters of the patient have died in infancy.

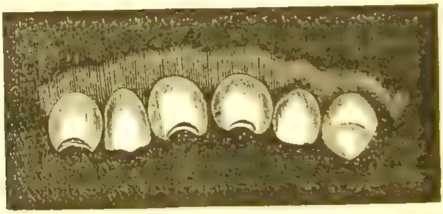

Fig. 38. From Mr. J. Hutchinson.

Exciting causes.—The disease sometimes supervenes on another ophthalmia. Injury of the cornea, or exposure to cold and wet, often appears to be the exciting cause. Sometimes the inflammation comes on after the retrocession of some eruption of the skin.

Diagnosis.—This ophthalmia is distinguished from phlyctenular ophthalmia by the difference in the changes which take place in the cornea; from the compound ophthalmiæ, in which the cornea is implicated, by the slight degree of redness of the white of the eye, and the peculiar changes in the cornea: from the chronic form, by the intolerance of light, and the greater opacity of the cornea, and the other changes in its appearance, mentioned in their proper places (p. 125).

When conjunctival opacity, thickening, and vascularity extend over the whole cornea, they conceal the affection of the proper substance; but the existence of this, and the distinction of such a case from that in which the conjunctiva corneæ alone, and not the proper substance, is affected, as it may be found in scrofulo-catarrhal ophthalmia, are indicated by the great intolerance of light, and by the increased prominence of the cornea, which generally after a time presents itself.

Course and prognosis.—Inflammation of the proper substance of the cornea is an obstinate disease. It may go on for a long time, alternately getting better and worse. Inflammation of the membrane of Descemet and iritis readily supervene, and the sclerotica, choroid, and ciliary body may also become involved, in which case there is added to the increased prominence of the cornea a conical projection of the whole front of the eyeball, in consequence of an attenuation and yielding of the anterior part of the sclerotica. Under such circumstances, the retina has usually also suffered; and there are consequently more or less amaurotic symptoms.

When the inflammation is arrested, the cornea clears sometimes very rapidly, and to an extent not previously expected. The clearing of the cornea takes place from the circumference towards the centre, where opacity usually lingers, and often continues fixed.

Increased prominence of the cornea having once taken place, is permanent.

Relapses are frequent.

Treatment.—This is to be conducted very much on the same plan as the treatment of phlyctenular ophthalmia. If the patient be a grown-up female, attention should be directed to the state of the menstruation.

The general abstraction of blood is not required, but the occasional application of leeches round the eye is generally necessary.

The bowels having been cleared out, the hydrargyrum c. creta and belladonna powders, or calomel, or the green iodide of mercury, in half-grain doses with one grain of powdered leaves of belladonna, may be given three times a day for a few days. It has not appeared to me that mercury is peculiarly called for in the treatment of this disease on account of its syphilitic origin. Mercury is beneficial merely because the inflammation is of an adhesive character.

Oil of turpentine, in doses of ʒß three times a day, often operates beneficially. It may be given in milk. I find it especially efficacious in combination with cod-liver oil (ʒij).

The calomel or green iodide of mercury with the belladonna night and morning and the cod-liver oil and turpentine twice a day, I often find beneficial.

Evacuation of the aqueous humour is of use, especially in cases with great distension of the cornea.

The use of the turpentine is not to be continued long, for if a good effect does take place, it generally appears within a week. The cod-liver oil, however, may in any case be continued, with or without a grain or two of quina in each dose.

Steaming the eyes with hot water impregnated with belladonna (p. 77), and bathing them with the belladonna or atropia lotion, in general soothe the eyes, and mitigate the intolerance of light. Belladonna is also of use for the purpose of keeping the pupil dilated (p. 140), when it is feared the iris has become affected.

If, after this, the acuteness of the disease be checked, quinine, bark and soda, or other tonics, such as iron, &c., according to the condition of the patient, will prove of great advantage. Counter-irritation is, at the same time, to be employed.

When the inflammation has been fairly arrested, the clearing of the cornea will be promoted by the occasional use of the bichloride of mercury lotion, the weak red precipitate ointment, or the like.

Inflammation of the ear with deafness, if it is not found already existing, often supervenes in cases of the disease under consideration. Sometimes, the inflammation is accompanied with discharge from the ear, but I have more frequently found the affection of the ear to be inflammation of the membrana tympani with ear-ache and deafness, but without discharge. I have often noticed that as the cornea cleared and vision improved the deafness became worse.

As to the treatment of the ear:—When there is ear-ache, two or three leeches behind the ear, and when they come off warm fomentations should be applied.

The general treatment for the eyes is that applicable for the ears.

Chronic or torpid form.

Objective symptoms.—Though there is not much redness of the eye to attract notice, still, on close examination, it will be found that it is pervaded by red vessels, both conjunctival and sclerotic, besides being dull and dirty-looking.

There is little exudation into the substance of the cornea—at the most, enough to produce streaks or clouds of opacity; but the most peculiar appearance which the cornea presents, is the roughness of its surface, like ground glass, and a dirty yellowish-green colour, as above mentioned (p. 114). The cornea is at the same time unnaturally prominent, sometimes increased in diameter, with corresponding enlargement of the anterior chamber.

Subjective symptoms.—There is merely dimness of vision, without any pain or intolerance of light.

In such cases more or less deafness from chronic inflammation of the membrana tympani is usually found established. Perhaps, there is otorrhœa.

Constitution.—The subjects of this form of corneitis are usually of a dull, leucophlegmatic, scrofulous habit.

Treatment.—The treatment applicable in this form of corneitis, will be understood from what is laid down in the preceding article. It should be rather tonic and alterative.

The diet and regimen above recommended for phlyctenular ophthalmia (p. 197), are equally called for in both the forms of corneitis now described.

3rd.—*Rheumatic corneitis.*[*]

When parenchymatous corneitis occurs in persons about middle age, as it sometimes, though not usually, does, it is accompanied by rheumatic characters, and it may, therefore, be designated *rheumatic corneitis.*

The following is an example of this species of inflammation of the cornea:—

A. E., aged 37, first seen Nov. 12.—Subject to rheumatism. The right eye has been affected for the last six or seven weeks; during all which time he has occasionally suffered pain over the eyebrow and in the temple. Yesterday the pain was more severe than it has yet been.

On examination (Nov. 12), the cornea of the right eye, in its upper third, was found quite red from vascular injection. In the rest of its extent, dim and rough on its surface. Considerable vascular injection of both conjunctiva and sclerotica, especially intense next the vascular part of the cornea. The palpebral conjunctiva congested, and the edges of the eyelids red, and slightly swollen.

Venesection to ℥viij. or ℥x., Dover's powder, gr. x., and calomel, gr. iij. at bed-time, followed by black draught next morning. After that, calomel gr. j. and opium gr. $\frac{1}{4}$, night and morning.

Nov. 14.—Eye is very much better to-day—the injection of the white of the eye considerably less; the vascularity of the upper part of the cornea, and the dimness of the rest of its extent very sensibly diminished.—To continue the calomel and opium, and to bathe the eye three times a day with warm water.

Nov. 23.—Much affected by the mercury. The inflammation subsiding very decidedly. The vessels in the upper part of the cornea much reduced in number.—To continue the calomel at bed-time only, and apply a blister behind the right ear.

25th.—Eye continues to improve. Mouth not quite so sore.

28th.—The inflammation is rapidly diminishing. The redness of the white of the eye has in a great measure disappeared, and the new vessels in the cornea going on to shrink one after the other.

Dec. 1.—The vessels in the cornea have still further shrunk.

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[*] Keratitis parenchymatosa rheumatica.

A few days after this some increase of the inflammation took place, but after the application of leeches and a repetition of the treatment, improvement again went on. The mercury was then omitted, and cod-liver oil given, under the use of which the inflammation wholly subsided;—the cornea became quite free from vascularity and cleared, with the exception of slight nebulæ at its upper part.

The characters of this form of inflammation are sufficiently defined to warrant the name. But it is to be observed that in an early stage, the case related might have been described as a case of inflammation of the sclerotica and tendinous insertion of the superior rectus.

It did not appear to me that there was anything syphilitic in this case.

Genus IV.—COMPOUND EXTERNAL OPHTHALMIA.

The ophthalmiæ, comprehended as species under this head, are scrofulo-catarrhal, and catarrho-rheumatic.

1st.—*Scrofulo-catarrhal ophthalmia.**

This is a combination of common scrofulous or phlyctenular ophthalmia and catarrhal; having sometimes more of the characters of the former, sometimes more of the characters of the latter, with occasionally an admixture of pustular ophthalmia.

Objective symptoms.—This form of ophthalmia not being attended by any great intolerance of light, the eyelids are not spasmodically closed, but usually kept half open. Their borders are red and swollen, and perhaps nodulated, from enlargement of the glandular structures situated there, and the eyelashes are incrusted with dried Meibomian secretion, which is poured out in increased quantity.

The vascular injection of the conjunctiva, both palpebral and sclerotic, is very considerable, and, though with less uniformity, presents the catarrhal characters. There may be also some sclerotic injection.

Pustules may present themselves on the sclerotic conjunctiva, and at the margin of the cornea, but the cornea itself may as yet be clear, or it may be the seat of onyx, or of phlyctenulæ or ulceration. The phlyctenulæ on the cornea usually reach a larger size than those which occur in common phlyctenular ophthalmia—indeed, they mature into pustules, and bursting, leave large ulcers, with flabby, everted, and perhaps red edges, into which large fasciculi of vessels run from the neighbouring conjunctiva and sclerotica.

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* Torpid form of scrofulous ophthalmia.

Instead of the cornea suffering in this way, the conjunctiva corneæ may be found in some parts of its extent the seat of exudation—opaque, thickened, and vascular. The vessels are closely arranged side by side, and extend over the margin of the cornea, in continuation from those of the conjunctival circumcorneal zone, and with the opacity, and thickening of the conjunctiva corneæ, stop abruptly (*vascular speck*).

The pupil is natural.

Lacrymation is comparatively inconsiderable, but there is a marked puromucous secretion from the conjunctiva, together with the increased discharge from the glands of the borders of the eyelids, above mentioned.

Subjective symptoms.—There is little intolerance of light or pain.

Constitutional symptoms.—There is no acute constitutional disturbance, but the patients are in general out of health—there is, perhaps, disordered digestion.

One eye alone may be affected, but often both. One is usually worse than the other, or it may be, that whilst one is affected more in the manner of a catarrhal ophthalmia, with the cornea clear, the pupil natural, and no intolerance, the other is affected more in the manner of phlyctenular ophthalmia—the cornea dim, the pupil contracted, and considerable intolerance of light.

Predisposing causes.—Perhaps this form of scrofulous ophthalmia is more disposed to occur in older subjects than common scrofulous or phlyctenular ophthalmia—more frequently about the age of puberty. It may be more generally connected with the torpid form of the scrofulous constitution, but it is to be observed, that in the same person one eye may be suffering from this form, whilst the other is suffering from the other. In females, disturbed menstruation often exists in causal connexion with the ophthalmia.

Exciting causes.—These are the same as the exciting causes of catarrhal, pustular, and phlyctenular ophthalmiæ. The inflammation may come on first as a catarrhal or pustular ophthalmia.

Diagnosis.—This ophthalmia differs from catarrhal principally in the early implication of the cornea—from phlyctenular ophthalmia, and from parenchymatous corneitis, in the less degree of intolerance of light, or the total absence of it, and in the greater redness of the white of the eye.

That form of scrofulo-catarrhal ophthalmia, in which there is opacity, thickening, and vascularity of the conjunctiva corneæ to a greater or less extent, and which is sometimes called *inflammation of the conjunctiva corneæ*, is distinguished from those cases of parenchymatous corneitis, in which there is, in addition, the same affection of the conjunctiva corneæ, by the characters above mentioned (p. 199), and by what of the proper substance of the cornea which may be still visible not being opaque and vascular. Practically, the distinction between the two diseases is important, as the affection of the conjunctiva corneæ in scrofulo-catarrhal ophthalmia may be efficiently treated by local remedies which would be injurious in parenchymatous corneitis.

Course and prognosis.—Pustules having formed on the sclerotic conjunctiva, a large superficial abrasion is produced if the inflammation goes on unchecked.

If ulceration of the cornea has taken place, it may remain superficial, and become covered with small sarcomatous growths or real red granulations, or the ulceration, though rather indolent, may go on to penetrate the cornea, the result of which will be as above described (pp. 119, 120).

When opacity, thickening, and vascularity of the conjunctiva corneæ (*vascular specks*) take place, they may gradually spread from several points of the circumference of the cornea, and to such an extent as to cover the whole cornea, forming what is called *pannus*.

The papillæ of the palpebral conjunctiva may become hypertrophied, constituting one form of granular conjunctiva.

Besides onyx, hypopyon may occur. Iritis, also, may supervene, if the cornea be much affected; but there is less tendency to iritis in this than in common scrofulous ophthalmia. When, however, internal inflammation does take place, there is perhaps a greater tendency for it to run into sclerotico-choroiditis, though this is a rare result in any case.

In consequence of the affection of the glandular structures at the borders of the eyelids, ophthalmia tarsi is liable to remain. Small abscesses at the roots of the eyelashes, and styes are also of frequent occurrence.

This ophthalmia is in general more easily cured than phlyctenular ophthalmia or parenchymatous corneitis, and the cure depends more on local treatment. General treatment, however, is also of great importance.

The prognosis in the course of the disease will depend on the extent to which the cornea is affected. In cases in which there are vascular specks on the cornea—vascularity, thickening, and opacity here and there of the conjunctiva corneæ, it may be prognosticated, that by a well-directed local stimulant treatment, the eye will be quickly freed from vascularity, any superficial ulceration of the cornea healed, and the cornea itself cleared, with the exception of some spots of gray opacity. It is to be kept in mind, however, that relapses are very apt to take place, especially if the state of the palpebral conjunctiva with its enlarged papillæ has not been improved.

Ulcers, though large and deep, in general heal readily under treatment, but of course leave *leucomata;* except they be of the transparent non-vascular kind, which leave a facet.

If the cornea has been penetrated by the ulceration, then the prognosis is unfavourable. Things will turn out as above mentioned (pp. 119, 120).

Onyx, if not to any great extent, readily disappears as the inflammation subsides.

Treatment — General.— Emetics are not in this ophthalmia of so much use as in phlyctenular ophthalmia, but the bowels require to be freely acted on, by repeated doses of calomel and jalap. After this, mercurial chalk may be given, in doses of two or three grains once or twice a day for a short time if the liver appear to be inactive.

The stomach and bowels having been put into order, tonics may be prescribed in addition to nourishing diet.

If the patient be a female about the age of puberty, attention must be directed to the state of the catamenial discharge.

Local treatment.—A few leeches may be applied to the eyes to begin with, or, if the palpebral conjunctiva be much gorged with blood, it is to be scarified.

The nitrate of silver solution is to be dropped into the eye once every second day; the bichloride of mercury eye-water is to be used twice a day, and the red precipitate salve to the edges of the eyelids at bed-time. Under this treatment the inflammation soon begins to subside, and the ulceration which was perhaps threatening to penetrate the cornea, is arrested.

In the chronic state, into which this ophthalmia is so apt to fall if neglected or not properly treated, free scarification of the palpebral conjunctiva, and thereafter the direct application of some strong stimulant, especially the strong red precipitate salve (p. 85), will be found to produce very decided results. The salve is to be introduced under the upper eyelid, and diffused over the whole surface of the conjunctiva, by rubbing with the point of the finger over the eyelid. Two or three such applications I have often found sufficient to remove the most marked appearances of the chronic disease, such as the vascularity and red specks of the cornea, and the injection of the sclerotic conjunctiva.

In the decline of the inflammation, counter-irritation behind and below the mastoid process, operates beneficially.

2nd.—*Catarrho-rheumatic ophthalmia.**

In this ophthalmia, there is a combination of the symptoms of catarrhal and rheumatic ophthalmiæ, with a greater tendency in the cornea to become the seat of phlyctenula or abscess and ulcer.

Catarrho-rheumatic ophthalmia is of much more frequent occurrence than rheumatic ophthalmia, but not so common as catarrhal. The comparative frequency of the three ophthalmiæ is usually stated thus:—Rheumatic, 1—Catarrho-rheumatic, 6—Catarrhal, 10.

Objective symptoms.—The edges of the eyelids are red and somewhat swollen. The white of the eye red, from both conjunctival and sclerotic injection. Generally, the sclerotic injection is great—the conjunctival only middling, but the contrary is sometimes the case. There is often some degree of serous chemosis, concealing the sclerotic injection. The redness of the palpebral conjunctiva is very considerable.

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* Conjunctivo-sclerotitis—Conjunctivo-sclero-keratitis.

The disease has not in general existed beyond a few days, before the cornea becomes implicated. The epithelium of the cornea may be raised up, by exudation underneath it, in the form of a large phlyctenula, or even blister (p. 114), or the exudation being into the proper substance of the cornea, and development into pus or puriform matter taking place, an onyx or abscess is the result (p. 115). By the bursting of the phlyctenula or blister, an ulcer is left, which may remain superficial and cicatrize without opacity, but it may also penetrate deep into the substance of the cornea—even through and through it. Ulceration may also take place when there is onyx or abscess; the cornea over the collection of matter ulcerates, the matter is evacuated, and a large deep ulcer is left, which may go on to penetrate the cornea through and through. Instead of thus bursting externally, the onyx or abscess may burst into the anterior chamber, and give rise to what is called false hypopyon.

This ophthalmia is attended by lacrymation in proportion to the intolerance of light. The conjunctival mucous secretion is increased, but in general not to a great degree, rarely to such a degree as to constitute blenorrhœa. The Meibomian secretion is poured out in increased quantity, so that the eyelids are glued together over night.

The iris and pupil are apt to become affected—the colour of the iris changed—the pupil contracted and sluggish in its movements, perhaps hazy from exudation. A deposit of matter at the bottom of the anterior chamber sometimes occurs, or a true hypopyon.

Subjective symptoms.—Along with the feeling as if sand were in the eye, indicative of the conjunctival affection, and which is most troublesome in the morning, there is the severe circumorbital or temporal pain coming on at night, characteristic of the sclerotic part of the ophthalmia, and the intolerance of light, which appears to be dependent on the implication of the cornea.

The conjunctival and sclerotic parts of the affection may commence at the same time, or the conjunctival first, or the sclerotic first; in the one case, catarrhal,—in the other, rheumatic, merging into catarrho-rheumatic ophthalmia.

Constitutional symptoms.—Considerable fever, and derangement of digestive organs—pulse generally quick and sharp—tongue white, and mouth ill-tasted—sleep prevented until towards morning by the nocturnal pain.

Causes.—The predisposing causes are much the same as those of rheumatic ophthalmia.

The exciting cause is very generally cold. The disease is most prevalent during north-easterly winds. A somewhat similar inflammation occurs from traumatic causes, such as abrasion of the cornea. See below.

Diagnosis.—This ophthalmia is distinguished:—

From catarrhal, by the superaddition of circumcorneal sclerotic injection, severe implication of the cornea, and the circumorbital or temporal pain (p. 161).

From rheumatic ophthalmia, by the superaddition of the conjunctivis, and the affection of the cornea, consisting in formation of phlyctenula or onyx and ulceration (p. 186).

From phlyctenular ophthalmia, by the age of the patient, and the circumorbital or temporal pain.

From parenchymatous corneitis, by the great redness of the white of the eye, and the difference in the kind of affection of the cornea (p. 199).

From iritis, by the absence of affection of the iris, or if present, by its comparative slightness, and by the presence of the corneal affection.

Prognosis and course.—The prognosis is good, when proper treatment is begun before the cornea is much or at all affected. The rheumatic symptoms depending on the sclerotic part of the disease usually decline first, he conjunctival part of the disease receding more slowly.

When the cornea is affected with ulcer or onyx, the prognosis is doubtful until a check has been put to the nflammation. According to the state in which the cornea is, so will be the prognosis, both as regards how soon recovery of the eye is likely to take place, and to what extent the recovery may be: opacities of the cornea, synechia anterior, or partial staphyloma, are liable to be eft.

Treatment.—This comprises first the general treatment of rheumatic ophthalmia:—Calomel (gr. iij.), extract of olchicum (gr. i.), and Dover's powder (gr. x.), at bedime, with black draught next morning. After that, ills of calomel (gr. j.), and Dover's powder (gr. ijß.), two or three times a day. Locally, warm fomentations, with water or belladonna or atropia lotion.

Subsequently when, as is usually the case, the inflammation is by this treatment checked, the local treatment for catarrhal ophthalmia may be had recourse to, viz.:—the nitrate of silver drops (gr. iv.—℥j.) at intervals of two or three days,—the bichloride of mercury lotion to bathe the eye with three times a day, and weak red precipitate salve to anoint the edges of the eyelids with at bed-time.

The bowels being free, cinchona-bark and bicarbonate of soda (āā gr. v. or gr. x.), or two grains of quina, three times a day, may be now prescribed with advantage, and counter-irritation behind the ear.

In old and weakly persons, especially if the inflammation has already existed for some two or three weeks before consultation, it is often necessary to commence this tonic treatment at once. A dose of calomel, and Dover's powder at bed-time, and black draught next morning, only being premised.

Often evacuation of the aqueous humour is useful in giving a first check to the inflammation, when the above treatment has failed in doing so; and it is especially beneficial when an ulcer threatens to penetrate the cornea. If it is the middle of the cornea which is threatened with penetration, the pupil should be kept dilated by belladonna, as above directed in phlyctenular ophthalmia (p. 196).

Order II.—OPHTHALMIA INTERNA ANTERIOR.

As genera of this order, *aquo-capsulitis*, *iritis*, and *kyklitis*, have been above admitted (p. 155).

In aquo-capsulitis, the inflammation involves not only the membrane of Descemet, but also the anterior surface of the iris. In kyklitis, the seat of the inflammatory congestion is in the ciliary body and processes, whilst that of the exudation is not only the anterior wall of the capsule of the lens, but also the uvea.

Seeing thus, that in both aquo-capsulitis, and kyklitis, the iris is superficially affected, some authors admit iritis as the only genus of ophthalmia interna anterior, and view aquo-capsulitis and kyklitis as species of iritis, under the names of *iritis serosa anterior* and *iritis serosa pos-*

terior; the species of iritis in which the whole substance of the iris is involved, being named *iritis parenchymatosa*.

Iritis serosa, however, does not comprehend all the cases which may be referred to the head of aquo-capsulitis and kyklitis; whilst there are, on the other hand, cases of iritis serosa which cannot be considered as coming under the head of aquo-capsulitis or kyklitis, but which properly come under the head of iritis only, especially as they are disposed to pass into iritis parenchymatosa.

Ophthalmia interna anterior may be acute or chronic. In the latter case, it is to be distinguished into that which has supervened on acute inflammation, and that which has had a chronic character from the first.

Ophthalmia interna anterior, in some one of its forms, may occur as a primary affection; but it may become more or less complicated with some degree of external or posterior internal ophthalmia, by extension of inflammation to the external or posterior tunics. On the other hand, it may arise secondarily by extension of inflammation from the external or posterior tunics.

To determine how the case stands in these respects, is an important point in the diagnosis, as both prognosis and treatment are much influenced by it.

Again, the different forms of anterior internal ophthalmia may occur as primary affections, or arise secondarily as extensions from each other. Indeed, it seldom happens but that one form is more or less complicated with some degree of another.

As the iris is always involved, either primarily and principally, or secondarily and to a greater or less degree, and as the affection of it constitutes the point on which the treatment especially hinges, the general observations which remain to be made on ophthalmia interna anterior have reference to iritis.

The *objective characters of iritis* in general have been above pointed out (p. 121, et seq.).

Of the *subjective symptoms*, the kinds of pain have been also referred to (p. 131). Here it is farther to be remarked, that the pain of rheumatic character around the orbit, in the temples, &c., though usually severe and considerable, is sometimes absent. The same may be said of the intolerance of light. As to the disturbance of vision, it is in proportion to the obstruction of the pupil, unless the posterior segment of the eyeball be at the same time involved, when, with photopsy, &c., the sight may be much impaired.

Constitutional symptoms.—Sometimes there is smart inflammatory fever,—sometimes, however, little or no constitutional disturbance.

Causes.—Scrofula, rheumatism, gonorrhœa, syphilis, gout, &c., act as predisposing, modifying, or even exciting causes of iritis. The disease is most frequent in adult age, less so before puberty and in old age. In infants, it is a manifestation of hereditary syphilis—in young persons, it is sometimes also owing to a congenital syphilitic taint, or is connected with the scrofulous diathesis—in adults it arises from rheumatism—common or gonorrhœal—or from syphilis—in old persons it is connected with gout. Males are more frequently the subjects of iritis than females. The left eye, it is said, is more prone to be affected—when the cause, of course, is of a general nature—than the right, and when both are affected, it usually suffers more.

Occasional causes.—Injuries, chemical or mechanical. Over-exertion of the eyes may act both as a predisposing and exciting cause; also exposure of them to too strong light and heat. Exposure to cold is a common exciting cause. Iritis is apt to be occasioned by the spread of inflammation from other parts of the eye—to supervene on external ophthalmia, or on posterior internal ophthalmia. One eye being affected, the opposite usually becomes affected also—and this even in traumatic cases.

Diagnosis.—In the diagnosis of iritis, attention is to be paid principally to the changes in the condition of the iris and pupil (p. 121, et seq.). The external redness, pain, &c., are not at all pathognomic, inasmuch as the same may occur in other ophthalmiæ, such as rheumatic, catarrho-rheumatic, &c. In these ophthalmiæ, however, as also in choroiditis, retinitis, &c., an extension of inflammation to the iris is prone to take place. When there is dilated pupil, it will probably be found that the iritis has arisen by extension of inflammation from the posterior tunics.

There are certain cases commonly described as chronic iritis, in which the disease proceeds to diminution or destruction of vision of one eye so insidiously, that the patient perhaps becomes aware of his malady only by accidentally discovering the defect of vision. On examination, the iris is found more or less altered in structure, and its pupillary margin adherent by bands of lymph to the capsule of the lens, which is perhaps the seat of some opacity, or even vascularity, but the pupil is dilated and may not be much, if at all, obstructed with lymph. The defect of vision, therefore, is not owing to the iritis, but is the result of chronic inflammation of the posterior segment of the eyeball, on which the affection of the iris has supervened. Such cases, therefore, properly come under the head of *ophthalmia interna posterior*. The other eye is liable, sooner or later, to become affected.

Prognosis.—The great danger of iritis is, that it may leave the pupil obstructed with lymph, contracted, or actually closed, or the anterior capsule of the lens opaque. Sometimes lenticular opacity supervenes. Another danger of iritis is, that the inflammation is apt to spread to the deeper parts of the eye, the ultimate result of which may be more or less complete disorganization of the organ—such as atrophy, dissolution of the vitreous body, hydrophthalmus, staphyloma scleroticæ, &c., with loss of vision.

Treatment.—The chief indication is to arrest the inflammation; in other words, to remove the inflammatory congestion as quickly as possible. It is by this only that a stop can be put to the exudation, and the condition established for the absorption of what matter has been exuded. It is by this, also, that the pain is most quickly and decidedly relieved. Bleeding and mercurialization are the principal means by which this indication is in general most effectually fulfilled. In some cases, however, as when the patient has had repeated relapses, and has been exhausted by the treatment, they are either not admissible, or a modification requires to be made in their employment. Oil of turpentine is sometimes of great use in such cases.

Another indication is, to guard the pupil from being contracted or closed by the exuded lymph. This is sought to be accomplished by keeping it, throughout the disease, under the influence of belladonna.

The treatment in chronic iritis consists chiefly in tonics and alteratives, such as bark and soda;—bichloride of mercury, in doses of from one-thirtieth to one-sixteenth or one-eighth of a grain three times a day, with bark and sarsaparilla;—or arseniate of potass, in doses of one-thirtieth of a grain, three times a day; counter-irritation being at the same time used.

Iridectomy has of late been sometimes advantageously performed in certain cases of chronic anterior internal ophthalmia with extensive adhesion of the pupillary margin of the iris to the capsule of the lens. Here we can understand that one effect of the operation is to establish a freer communication between the anterior and posterior chambers of the aqueous humour (p. 151).

Genus I.—AQUO-CAPSULITIS.*

Aquo-capsulitis.

In the disease to which this name has been given, the inflammation involves the membrane of Descemet on the one hand, and the anterior surface of the iris on the other —sometimes the one, sometimes the other being the part first or most affected—sometimes both at the same time, and equally. The disease occurs either in an acute or chronic form.

The external redness, which is slight, is owing principally to sclerotic circumcorneal, with more or less scattered conjunctival injection. Between the redness and the margin of the cornea, there sometimes intervenes the narrow bluish-white ring, usually called the *arthritic ring* (pp. 22, 23).

The affection of the membrane of Descemet is manifested by deep-seated dimness, interspersed with grayish or yellowish-white specks, from the size of a pin's head to microscopical minuteness, of the cornea, produced, as above mentioned (p. 116), by exudation between the proper substance of the cornea, and the membrane of Descemet. There are no vessels in this situation, and if subsequently vessels make their appearance, they are of new formation.

The affection of the iris is manifested first by the usual loss of brilliancy and change of colour, by contraction and sluggishness, or immobility of the pupil, and by exudation of lymph into the pupil, and on the surface of the iris, where subsequently new vessels may make their appearance.

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* Inflammation of the membrane of the anterior chamber of the aqueous humour—Keratitis serosa—Iritis serosa anterior—Kerato-iritis.

Along with these changes in the membrane of Descemet and iris, there is increased accumulation of aqueous humour, causing abnormal distension, if not prominence, of the cornea—an effect of which distension is dimness or suffusion of the corneal substance, superadded to the mottled opacity from exudation between it and the membrane of Descemet.

When the opacity of the cornea is not so great as to conceal the parts behind, flakes of lymph may be observed in the aqueous humour. Sometimes there is hypopyon.

Subjective symptoms.—A feeling of distension and fulness in the eyeball, with a dull aching pain in the forehead, sometimes extending to the occiput, distresses the patient. In acute cases, circumorbital or temporal pain occurs in nocturnal paroxysms, as in rheumatic ophthalmia and iritis.

Intolerance of light and lacrymation exist, but not to a great degree.

Vision is disturbed in proportion to the degree of opacity from exudation into the pupil, and between the substance of the cornea and membrane of Descemet.

Constitutional symptoms.—In acute cases there is some febrile disturbance.

Causes. — The scrofulous constitution, or other disordered state of health which usually exists, and especially a congenital syphilitic taint, belong to the head of predisposing causes.

The disease is sometimes excited by chemical injury. In the disordered state of health just alluded to, such causes as over-exertion of the eyes, and suppressed perspiration, have been found to excite the disease. It most usually occurs in persons below middle age.

Diagnosis.—Aquo-capsulitis requires to be distinguished from common corneitis on the one hand, and from common iritis on the other. From common corneitis, it is distinguished by the deep situation, and the peculiar mottled appearance of the opacity of the cornea; and the presence of this opacity, in addition to the changes in the iris, distinguishes the disease from simple iritis.

Prognosis.—The disease, especially the chronic form of it, is sometimes obstinate. Relapses are liable to occur.

Treatment.—This should be much the same as is above recommended for parenchymatous corneitis, with the addition of a more decided use of mercury for the accompanying iritis. The treatment may be commenced with an emeto-cathartic (p. 162), after which mercury should be given, so as to affect the gums slightly. Quinine may be administered at the same time, or afterwards, according to circumstances.

Turpentine is sometimes efficacious, as above mentioned, in corneitis (p. 200).

If the inflammation does not begin quickly to subside, the operation of evacuating the aqueous humour (p. 149) should be had recourse to. It was in this disease that Mr. Wardrop first recommended *paracentesis corneæ*.

Counter-irritation is of great use in the decline of the disease.

As a fomentation, and to keep the pupil dilated, the belladonna or atropia lotion (p. 80) may be prescribed.

No irritating drop or salve is admissible.

Genus II.—IRITIS.

The species or varieties of iritis to be considered here, are such cases as are primary, or at most occur only as extensions from the external tunics. Those cases of iritis which occur as extensions of posterior internal inflammation, will be considered under the head of ophthalmia interna posterior.

The varieties of primary iritis are—scrofulous, rheumatic, syphilitic, and arthritic, the two former coming under the head of *iritis serosa*, the two latter under that of *iritis parenchymatosa*. In many cases, certain of these varieties of iritis are variously mixed up or complicated with each other—a circumstance which requires to be taken into consideration in forming a diagnosis, delivering a prognosis, and planning the treatment.

1st.—*Scrofulous iritis.**

In phlyctenular ophthalmia, the inflammation, as above mentioned (p. 194), is liable to extend to the anterior surface and pupillary circle of the iris. In some cases, the iris appears to be primarily affected. These are the cases spoken of as cases of scrofulous iritis.

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* Ophthalmia scrofulosa interna anterior.

In addition to the treatment above indicated for the phlyctenular ophthalmia, it is necessary to give mercury so as to affect the gums, with the precautions which the constitution of the patient requires; or, instead of mercury, oil of turpentine with or without cod-liver oil, as above indicated, may be tried. The pupil should be kept under the influence of belladonna.

In parenchymatous corneitis, we have seen that iritis often supervenes (p. 198). For this, whether connected with a congenital syphilitic taint or not, the treatment just indicated is also applicable.

To chronic iritis in connexion with chronic corneitis, chronic inflammation of the posterior tunics is sometimes superadded. A tonic and alterative treatment is indicated in such cases. Arsenical solution in three minim doses, two or three times a day, with or without iron, is particularly beneficial.

2nd.—*Rheumatic iritis.*

In rheumatic and catarrho-rheumatic ophthalmiæ, it has been above seen (pp. 185, 208), that the iris is liable to be somewhat involved in the inflammation. When in an ophthalmia occurring under the same circumstances as rheumatic or catarrho-rheumatic ophthalmia usually does, the iris is the principal seat of the inflammation, the case is conventionally said to be one of *rheumatic iritis*—and this whether the patient has been subject to rheumatism in any other part of the body or not.

Rheumatic iritis constitutes what is called an *iritis serosa anterior*, as the inflammation principally affects the anterior surface of the iris. It may, however, also extend to the proper substance of the membrane.

Symptoms at the commencement.—Slight superficial pain of the eye, with increased sensibility to light and lacrymation, first attract the attention of the patient. On examination, the white of the eye may be found but slightly red, and this principally from scattered conjunctival vessels. No change may be perceptible in the iris, except, perhaps, that it is dull looking, and its pupillary margin not so sharply defined as natural. As regards the pupil, its motions may be as yet unimpeded.

Sclerotic circumcorneal zonular injection now becoming well marked, the appearance of the iris changes—first in its lesser circle, which is reddish and swollen—the pupil becomes dim, contracted, and sluggish, the pain in the eye increases, and after a nocturnal paroxysm of circumorbital or temporal pain, exudation of lymph is discovered to have taken place. The disease is thus fully formed.

Symptoms in the fully-formed state.—Objective symptoms.—As has been above more particularly described (p. 121, et seq.), the white of the eye is red from sclerotic circumcorneal, and more or less conjunctival, injection. The colour of the iris, if naturally blue, is now green, if naturally hazel, reddish-brown. Exuded lymph is seen in the now fixed and distorted pupil, and sometimes in flakes suspended in the aqueous humour.

Besides these changes, the cornea is distended from increase in the quantity of aqueous humour (p. 122); it is more or less dim; and if the inflammation has involved the membrane of Descemet, the deep punctiform opacities, indicative of this, are presented.

The palpebral conjunctiva is injected, and the eyelids towards their tarsal borders are somewhat red and swollen.

Subjective symptoms.—Besides the nocturnal paroxysms of circumorbital or temporal rheumatic pain, such as occur in rheumatic or catarrho-rheumatic ophthalmia, there may be a painful feeling of distension in the eyeball, and a dull pain extending from the forehead to the occiput.

There is much intolerance of light, accompanied by lacrymation.

Vision is very considerably disturbed.

Constitutional symptoms.—Rheumatic iritis, like rheumatic ophthalmia, is attended by inflammatory fever, manifested by the usual symptoms of full strong pulse, white and dry tongue, costiveness, thirst, loss of appetite, and sleeplessness. The want of sleep is in part due to the severity of the nocturnal pain.

The causes, predisposing and exciting, of rheumatic iritis, are the same as those of rheumatic ophthalmia (p. 186). Rheumatic iritis, along with rheumatic inflammation of the joints, sometimes occurs, as a consequence of gonorrhœa. (See *gonorrhœal rheumatic iritis.*) A similar iritis is apt to occur during or after the use of mercury, the mercury rendering the system more susceptible to the action of cold. The iritis having once occurred, leaves a predisposition to subsequent attacks.

One eye only, or both, may be affected. In the latter case the inflammation is usually more severe in the one than in the other.

Diagnosis.—The diagnosis of the disease, in its fully formed state, as an iritis, being made (p. 212), its rheumatic nature is determined, as above said, principally by the circumstances under which the attack has come on, taken in conjunction with the character of the symptoms.

Prognosis.—The prognosis is in general good if the disease is taken in time, before much exudation has occurred, and properly treated. In this case it may be cured in three or four weeks. A tendency to relapse, however, remains; but this is less, the more rapidly and effectually the inflammation has been subdued.

Left to itself, or improperly treated, the inflammation may fall into a chronic state, or it may eventually subside, but perhaps not until by exudation of lymph the pupil is obstructed or actually closed, or the anterior capsule opaque, and the eye is rendered more or less completely unfit for vision. The progress of the healing process of iritis, in general, as described in p. 123, is quite applicable to rheumatic iritis.

Treatment.—After bloodletting, if such should be thought necessary, three or four grains of calomel, and ten or fifteen grains of Dover's powder, are to be given at bedtime, and next morning an aperient draught. The calomel and Dover's powder are then to be continued in smaller doses (gr. j.—gr. ijß.) every four hours, until the gums are sore,—or the calomel and Dover's powder night and morning only, with oil of turpentine in half-dram doses forenoon and afternoon.

If, under this treatment, the inflammation does not show indications of subsiding, leeches may be applied, after which, probably, an evident diminution of the severity of the disease will take place.

Low diet is to be enjoined, and the bowels kept open with black draught, or an emeto-cathartic. Rest and quiet, and protection of the eyes from strong light, are important parts of the treatment.

The eye may be occasionally bathed with the belladonna or atropia lotion, after which it is to be carefully dried, and covered lightly.

To assist in warding off nocturnal pain, inunction over the pained part is to be made with mercurial ointment and belladonna, opium, tincture of tobacco, &c., as above indicated for rheumatic ophthalmia.

When the inflammation begins to yield, counter-irritation repeated occasionally will promote the cure.

The violence of the disease subsiding, absorption of exuded matter commences. After this, improved diet, and bark or quinine, may be ordered.

When circumstances forbid the use or longer continuance of mercury, turpentine alone, as above recommended, may be tried as a substitute, in doses of ʒſs. to ʒj., three times a day.

In a case of rheumatic iritis, treated by venesection and mercurialization, in which after convalescence a relapse took place, forty drops of turpentine were ordered three times a day. The report, the second day after, was as follows:—Has taken five doses of turpentine. The eye is to-day very much better. States the improvement began yesterday. The action of the mercury on the mouth had become very much diminished, but since taking the turpentine the patient finds the mouth rather severely affected again.

3rd.—*Gonorrhœal rheumatic iritis.*

Men, rarely women, who have suffered from gonorrhœa often remain subject to severe attacks of rheumatism, one of the manifestations of which is iritis. This disease of the eyes is very liable to relapse, and by neglect or mismanagement often ends in much impaired or lost sight.

Gonorrhœal rheumatic iritis is characterised by similar but usually more severe symptoms than ordinary rheumatic iritis—the inflammatory congestion and pain being greater, and the exudation of lymph into the pupil more copious. But the most distressing feature of the complaint, perhaps, is its great tendency to relapse, especially if it has not been efficiently treated in the first instance.

Gonorrhœal rheumatic iritis usually occurs first after the discharge from the urethra has ceased. It may precede, accompany, or follow rheumatic inflammation of the joints. Sometimes the iritis and the synovitis alternate. Sometimes the iritis is the sole manifestation of gonorrhœal rheumatism, and may not come on until a considerable time after the attack of gonorrhœa.

Treatment.—The plan of treatment above laid down for ordinary rheumatic iritis, is applicable for gonorrhœal iritis. Iridectomy has been sometimes had recourse to, in the hope of warding off the relapses of gonorrhœal rheumatic iritis to which some persons are so painfully subject. Iridectomy, however, may not secure the eyes against even a first attack of gonorrhœal rheumatic iritis, as was shown in the following case:—

Some years ago I had a man under my care in the hospital with gonorrhœal ophthalmia affecting both eyes. When I first saw him, there was considerable chemosis, and both corneæ had become opaque. Fortunately, they were saved from destruction. But after the subsidence of the inflammation, though clearing of the corneæ took place to a very great extent at the circumference, opacity still lingered in the centre so as to obstruct the sight completely. I therefore performed the operation for artificial pupil by lateral excision on both eyes. The irides were at this time quite sound.

The man gained pretty useful sight, and went on well for some two or three years, when he had an attack of general gonorrhœal rheumatism, in the course of which the eyes became affected with very severe and stubborn iritis. The condition of one eye in particular remained after this very much deteriorated.

If iridectomy thus does not secure against a first attack of iritis, it is not likely to secure the sufferer against a relapse. It has, however, the effect of saving the eye from the closed or obstructed pupil, which is so liable to result from repeated attacks, and may, therefore, often be advantageously performed (p. 151, et seq.).

It is to be remarked, that if iridectomy be performed while the iris is still in a state of acute adhesive inflammation, the cut edges not becoming much retracted from each other are liable to be reunited by the lymph poured out from them. Matters are thus rendered worse than before.

The earlier and more completely the first attack has been subdued, the less liability there is to relapses.

Prevention of relapse.—A person who has once suffered an attack of iritis should carefully guard against sudden transitions from heat to cold, violent exertion, late hours, much reading and writing, and, at the same time, attend strictly to his diet. Sea-bathing is sometimes useful in strengthening the system against the susceptibility. When a person has become a martyr to relapses, residence in a southern climate during two or three successive winters may be the means of saving him from his dreaded attack, and of breaking up the tendency.

4th.—*Syphilitic iritis.*

Internal inflammation of the eye is one of the manifestations of constitutional syphilis, presenting itself usually as a late secondary or as a transition symptom.

Iritis involving the whole substance of the iris (*parenchymatous iritis*), is the most common form of syphilitic internal ophthalmia, but the inflammation is very liable to spread to the posterior tunics of the eye. Sometimes, as we shall see, the posterior tunics are the parts first and chiefly affected, the iris only becoming implicated secondarily.

Objective symptoms.—In the fully formed state of syphilitic iritis, there is well-marked external redness, not only from the usual sclerotic circumcorneal injection, which is great, but sometimes also from considerable conjunctival injection—the brick-red colour of which may obscure the rose tint of the sclerotic injection. Through the dim and muddy-looking cornea, and aqueous humour, the iris is seen dull, and changed in colour, but more intensely so than usual on account of the greater vascular congestion, especially at its inner circle, where the colour is reddish-brown or tawny. The surface of the iris may present small points of extravasation of blood.

There is copious exudation of lymph into the pupil, into the substance, and on the surface of the iris, besides flakes diffused in the aqueous humour. I have seen the anterior chamber become quite filled with lymph. In the deposits of lymph on the surface of the iris, new vessels may be developed, so that they present the appearance of reddish-brown or yellow tubercular excrescences. The exudation into the substance of the iris causes the swelling and thickening of it, which appears first at the margin of the pupil, either partially or equally all round.

Abscess is apt to form in such cases, as above described (p. 123), which bursting, gives rise to hypopyon.

The pupil is found variously altered :—fixed, contracted, angularly distorted; displaced upwards and inwards, more or less filled with lymph, its margin adherent to the capsule of the lens, and apparently retracted on account of the prominence of the surface of the iris, arising from the swelling and thickening of its substance.

Subjective symptoms.—During the day, there is in general not much pain, but at night, the paroxysms of circum-orbital or temporal pain are sometimes peculiarly severe. There is intolerance of light and lacrymation. Sometimes, however, there is neither pain nor intolerance of light. Vision is considerably diminished in consequence of the great obstruction of the pupil, but it is still more disturbed if the posterior tunics have become implicated, in which case there is, moreover, photopsy.

State of health and general symptoms.—Besides the iritis, there are usually, or have been, though not always, other constitutional symptoms present, such as swelling of the lymphatic glands of the neck, axilla, &c., eruptions, papular, scaly, tubercular, or pustular, ulceration of the throat and mouth, periosteal swellings, and pains in the limbs.

There may be considerable inflammatory fever, though sometimes very little or none at all.

Both eyes generally suffer—one eye becoming affected after the other.

The disease is often insidious in its attack, commencing with slight symptoms. It may then assume an acute character, or, with symptoms still mild, continue to observe a chronic but not less destructive course.

Causes.—The constitutional disease appears to be, in some cases, both predisposing and exciting cause, but in other cases, the disease is excited by some occasional cause, such as exposure to cold, over use of the eyes, a slight injury, &c. Thus, though any person may be attacked with iritis, it is only when contaminated at the time with syphilis that the liability is so great, and that the disease presents the characters of syphilitic iritis—characters which are such as clearly depend on a morbid condition of the blood.

Diagnosis.—Though the tawny colour of the smaller ring of the iris, the angular distortion and displacement upwards and inwards of the pupil, and the presence of the lymphy deposits on the surface of the iris, may some of them be met with in cases of iritis, not syphilitic, and may some of them be absent in syphilitic cases, they, nevertheless, are of such frequent occurrence in syphilitic iritis, that their presence alone constitutes strong ground for suspecting the nature of the case, and for inquiring as to whether or not other constitutional symptoms exist. If such do exist, the nature of the case can no longer be doubtful.

The differences between a well-marked case of common iritis and a well-marked case of syphilitic iritis might, perhaps, be all referred to a more intense vascular congestion, and a more copious exudation of lymph in the latter; the vascular congestion indicated by the great redness of both conjunctiva and sclerotica, and discoloration of the iris; the exudation of lymph indicated not only by the obstruction of the pupil, but also by the thickening of the iris from interstitial infiltration, the deposits on the iris, and the flakes in the aqueous humour. The tawny discoloration of the pupillary circle of the iris, which has been so much insisted on as a characteristic of syphilitic iritis, appears to be owing to the intense vascular injection of that part with interstitial exudation of lymph, and, perhaps, extravasation of blood in the first place, and deposit of pigment in the second.

Prognosis.—This is a very dangerous form of iritis. Left to itself, or inefficiently treated, it may spread to other parts, such as the choroid, retina, vitreous body, &c., and occasion disorganization of the whole eye, with consequent loss of vision.

In otherwise healthy persons, if timely and properly treated, the disease may be perfectly cured. It often, however, happens, especially when the health has been much pulled down by the general disease, that even when the iritis has been subdued, the eye remains for a long time weak, and relapses are liable, from slight causes, to be excited.

Treatment.—Bleeding and mercurialization are the great remedies in this as in rheumatic iritis—the mercurialization, however, not solely because the disease is syphilitic. The venesection may require to be repeated more than once, and the mercury (calomel and opium) must be pushed until decided salivation. After this the mercury may still be required to be continued in smaller doses, to promote the removal both of the effects of the iritis and of the constitutional disease.

Besides belladonna, to oppose the contraction of the pupil, anodyne frictions are made, as above prescribed in rheumatic ophthalmia and iritis, around the orbit or on the temple, to assist in mitigating the nocturnal pain.

When the disease has been checked by the bleeding and mercury, blisters are useful.

When, as sometimes happens, it is not advisable to push mercury to the necessary extent, or when mercury does not exert its usual curative effects, turpentine, in dram doses, three times a day, is the next remedy on which most dependence can be placed in subduing the iritis.

Iodide of potassium may be also tried under such circumstances, provided the pupil is not obstructed with lymph, for in this case the effect of the iodide will be to consolidate and fix the lymph, so as to arrest the absorption of it, as explained above (p. 139). It may be given in doses of three or four grains, in compound decoction of sarsaparilla, three times a day. In any case it is necessary to follow up the mercury with the iodide of potassium.

5th.—*Iritis in Infants hereditarily affected with syphilis.*

An inflammation of the conjunctiva implicating the cornea and edges of the eyelids, has been above noticed under the name of *Congenito-syphilitic ophthalmia neonatorum* (p. 180).

Here, we have to consider *iritis*, which may also present itself in *infants hereditarily affected with syphilis.*

The disease is characterised by more or less marked zonular redness, discoloration of the iris, and exudation of lymph into the pupil. The lymph may be in such quantity as to fill the pupil, and is sometimes red from the development of new vessels in it.

Most generally both eyes are affected with the iritis.

In some cases, syphilitic iritis presents itself in infants unaccompanied by any marked syphilitic symptoms, but on inquiry and examination sufficient evidence will usually be obtained as to the existence of the hereditary constitutional disease on which the affection of the eyes depends.

There are most frequently cutaneous eruptions, soft sores around the anus, impetiginous crusts on the face, coryza with snuffles, &c.—perhaps also the morbid state of the conjunctiva, cornea, and edges of the eyelids before spoken of.

Treatment.—Half grain doses of calomel or green iodide of mercury should be given three times a day, and belladonna or atropia lotion used to bathe the eyes with.

In a majority of cases this treatment will be found successful in subduing the inflammation and promoting the absorption of the exuded lymph in the pupil. In some cases, however, the pupil of one eye remains obstructed.

If it should be considered desirable not to give mercury by the mouth, Mr. Harrison recommends the use of a flannel kneecap smeared with the weaker mercurial ointment daily, and sponging the infant's body with the solution of the corrosive sublimate of mercury, gr. j.—ij. —to water ℥viij.*

6th.—*Arthritic iritis.*†

In this, as in syphilitic iritis, the inflammation involves the substance of the iris (*parenchymatous iritis*).

Objective symptoms.—The redness of the white of the eye, which is owing not to sclerotic only, but also to considerable conjunctival injection, inclines to a livid tint. This is owing to the venous character of the conjunctival congestion, including the varicose enlargement of the rectal veins. Sometimes also to a dark tinge of the sclerotica in the region of the ciliary body.

Between the margin of the cornea and the redness of the white of the eye, there usually intervenes, either at the nasal and temporal sides only, or all around, a narrow bluish-white space, forming a more or less perfect ring round the cornea. Under the impression that this appearance is peculiar to arthritic inflammation of the eye, it has been named *arthritic ring*, but improperly, as above shown (pp. 22, 23).

This disease being a parenchymatous iritis, the iris is not only dull and discoloured as usual, but also swollen, especially at the pupillary margin, which becomes retracted and adherent to the capsule of the lens, while the middle part of the iris is bolstered forward towards the cornea.

The pupil, at first contracted, may become filled with lymph, mixed, perhaps, with blood, and angularly distorted—sometimes wholly closed.

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* "The Pathology and Treatment of Venereal Diseases," p. 149. London, 1860.

† Ophthalmia arthritica interna anterior.

In consequence of the considerable degree of conjunctival congestion, there is some increased mucous secretion, and in consequence of the affection of the borders of the eyelids, which are red and swollen, there is increased Meibomian discharge. These matters, by the movements of the eyelids, collect towards the angles of the eyes, in the form of a whitish foam, which has been named *arthritic foam*, as if the appearance were peculiar to arthritic inflammation of the eye; but it is not, for the same appearance presents itself in other cases of ophthalmic inflammation.

Subjective symptoms.—Sometimes an attack of the disease is preceded by formication in the skin of the face, and a tingling sensation about the eye. Dependent on the conjunctival injection, there may be the sensation of a foreign body in the eye. There is also a feeling of fulness and distension of the eyeball; but the most distressing symptom is the racking pain, not only around the orbit and in the temple, but over the whole side of the head and face. It is most severe at night, but may not be wholly absent even during the day.

Intolerance of light exists to a greater or less degree, accompanied by lacrymation.

Vision is impaired only in proportion to the exudation into the pupil, or the dimness of the lens which sometimes supervenes, except when the posterior tunics are involved (see below), when it is impaired to a much greater degree or even lost.

Usually one eye only is affected.

Constitution, state of health, and constitutional symptoms.—The persons who become affected with this disease are usually above middle age, and suffer from bad digestion or are of broken down constitution. They may or may not have been the subjects of regular gout. The disease when formed is attended by considerable inflammatory fever.

Causes.—The state of constitution just described may be viewed as the predisposing cause, and sometimes as exciting cause also, seeing that the disease may come on without any evident external exciting cause. More frequently, an inflammation of the eye being called forth by some exciting cause, such as over-exertion of the sight, damp and cold, injury or operation, &c., the state of the constitution causes it to assume the arthritic character. The patient will often be found to have suffered from previous attacks of inflammation of the eye.

Diagnosis.—The local symptoms, and the state of the constitution, point to the arthritic character of the disease; but the form of arthritic iritis under consideration requires to be distinguished from that which is a radiation or extension of *arthritic inflammation of the posterior tunics.* The principal ground of diagnosis is, that in the latter case, along with irregular gout, the primary symptoms indicate posterior internal ophthalmia, such as sclerotic redness at the circumference of the eyeball, diminishing towards the cornea, photopsy, and rapid diminution of vision. Consequently the pupil, when the disease extends from the posterior tunics, instead of being contracted, is dilated (and this perhaps more in one direction, so that it presents an oval shape), and is not the seat of so much if any, lymphatic exudation; the lens, however, is seen to have become glaucomatous.

Prognosis.—This is a very dangerous form of iritis—not only because the pupil is apt to become contracted and obstructed by exuded lymph, but because the inflammation is very obstinate, prone to relapse, and after several attacks, to spread to the choroid, retina, &c., and totally destroy vision.

Treatment.—Though this inflammation is so dangerous to the eye, and is attended by such severe symptoms, the state of the constitution is usually such, that the active treatment, so beneficial in other cases of iritis, requires to be very cautiously employed.

The treatment which I have generally found the most safe and beneficial has been the occasional application of leeches; calomel gr. ij, extract of colchicum gr. j. and Dover's powder gr. v—x., every night at bedtime; and black draught in the morning when required.

Evacuation of the aqueous humour will generally be found beneficial in giving a check to the inflammation and relieving the pain.

To relieve the racking pain, friction may be made with one or other of the substances above mentioned (p. 187). —Sometimes one, sometimes another, will be found more efficacious. No application should be made to the eye itself.

The diet should be at first restricted, but when the violence of the inflammation has subsided, it may be improved, though it should still be temperate and carefully regulated. Tonics may also be given—for instance, bark, and soda, five or ten grains of each, or two grains of sulphate of quinia two or three times a day.

Counter-irritation behind the ear, or on the nape of the neck, is a very useful and necessary part of the treatment, but only when the disease has begun to decline.

Genus III.—KYKLITIS OR INFLAMMATION OF THE CILIARY BODY.

Inflammation of the ciliary body manifests itself chiefly at first either as a *sclerotico-kyklitis* or as an *irido-periphakitis*, though eventually both forms of the inflammation may come to be combined.

Often they form a part of a general sclerotico-choroiditis. See posterior internal ophthalmia.

1st.—*Sclerotico-kyklitis.*

Under this name, I include that form of inflammation of the ciliary body, in which the corresponding part of the sclerotica participates, and in which the iris is secondarily involved. See the description of it above given at p. 124, and Plate III., fig. 2.

The inflammation is, in general, slow in its progress, and is liable to lead either to circumscribed anterior sclerotic staphyloma or a general staphylomatous prominence of the whole anterior segment of the eyeball.

Treatment.—The tonic and alterative plan of treatment is that which is most generally applicable. The bichloride of mercury is to be given in doses of one-sixteenth to one-eighth of a grain three times a day in tincture of bark, or the arseniate of potass in doses of one-thirty-secondth of a grain either in the form of Fowler's solution or in that of pill combined in the one case with ten minims of tincture of belladonna, or in the other with one or two grains of powdered leaves of belladonna.

During an exacerbation of the inflammation the abstraction of blood by leeches is necessary.

The belladonna or atropia lotion is to be used to bathe the eye with.

Iridectomy has been recommended in the hope of preventing the formation of the sclerotic staphyloma.

2nd.—*Irido-periphakitis.**

In this inflammation, the uvea and the anterior wall of the capsule of the lens are the seat of the exudation; while the ciliary processes appear to be the seat of the inflammatory congestion.

The anatomical characters have been above given (pp. 124—128).

The disease in general observes a chronic course.

Objective symptoms.—There is not much external redness. The iris is slightly or not at all discoloured, though, perhaps, dull looking; the pupil, bordered by a fringe of uvea, is somewhat contracted, irregular in form, and either fixed or very sluggish in its movements. On close examination, patches of opacity, some of them tinged of a brown colour, may be seen on the anterior wall of the capsule with minute vessels terminating in them. If belladonna be applied, and the pupil yields to its influence, the few red vessels, which were previously seen coming from behind it, are discovered to be derived from a looping net-work on the crystalline, forming an interrupted circle concentric with the pupil. This network may appear to the naked eye like mere brownish-red patches, but by the help of a magnifying glass, of one inch, or one half inch focus, the component vessels will be discovered. Between the vascular patches on the anterior wall of the capsule, and the membrane on the posterior surface of the iris, bands of adhesion may extend, preventing the free dilatation of the pupil.

Subjective symptoms.—The dull pain in the eye and head which attends this inflammation is seldom such as to cause much distress; and any intolerance of light is so little, that the examination of the eye is not attended with much uneasiness. Muscæ volitantes, and photopsy, however, sometimes disturb the patient, and the dimness of vision is greater than the mere suffusion of the lens would alone indicate, showing implication of the posterior tunics.

Prognosis.—In the early stage of irido-periphakitis, resolution is sometimes brought about; but, when the disease has existed for some time, it remains very obstinate.

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* Inflammation of the membrane of the posterior chamber of the aqueous humour—crystallino-capsulitis anterior.

Treatment.—The general treatment employed in anterior internal inflammation of the eye, viz., depletion, mercury, counter-irritation, and belladonna, in the early stage, and tonics in the latter stages, are the remedies which suggest themselves; but their employment must be regulated and modified according to the circumstances of the case.

Dr. Mackenzie mentions the following circumstances in regard to a case of inflammation of the anterior hemisphere of the capsule, which he treated. On the first day of his being called in, two minute reddish spots were seen projecting from behind the edge of the pupil. Next day there were five. In the course of a week, the symptoms totally disappeared, under the employment of venesection, leeches, calomel with opium, and belladonna. The mouth was made very sore. In the chronic stage, Dr. Mackenzie confesses, however, that this inflammation has in his hands proved one of the most obstinate.

In chronic irido-periphakitis, iridectomy has been performed with advantage (p. 151, *et seq.*).

Order III.—OPHTHALMIA INTERNA POSTERIOR.

Under this name I comprise inflammation of the internal structures of the posterior segment of the eyeball, viz., the choroid, retina, and vitreous body.

The anatomical characters of ophthalmia interna posterior, and the morbid alterations of structure produced thereby, so far as they have been observed by means of the ophthalmoscope, have been above indicated (pp. 52, 124.) There are no external objective symptoms exactly pathognomic of it. As subjective symptoms, there may be deep-seated distending pain in the eyeball, pain in the head extending to the occiput, intolerance of light, photopsy, and dimness of sight. Of all these symptoms, the dimness of sight, without sufficient cause in the dioptric parts of the eye, is the most constant and characteristic.

As shown at p. 212, posterior internal ophthalmia may arise and proceed to diminution or destruction of vision in one eye, so insidiously, that the patient perhaps becomes aware of his malady only by accidentally shutting the opposite eye. On the other hand, the disease may run on to destroy vision with rapidity and amidst great suffering. Hence the distinction of ophthalmia interna posterior into acute and chronic. In the chronic inflammation, exacerbations may supervene.

Ophthalmia interna posterior may arise primarily or secondarily.

In primary ophthalmia interna posterior, an extension of the inflammation usually takes place ere long to the anterior segment of the eyeball. It is of the ophthalmia interna anterior thus supervening that the sclerotic circumcorneal injection which presents itself is symptomatic, not of the posterior internal inflammation. Such cases of ophthalmia interna posterior, with secondary ophthalmia interna anterior, are distinguished from primary ophthalmia interna anterior by the changes in the anterior segment of the eyeball not being such as to account for the diminution or loss of vision, and by this diminution or loss of vision having occurred or at least commenced, perhaps, before the changes in the anterior segment presented themselves.

Secondary ophthalmia interna posterior arises by extension of inflammation in ophthalmia interna anterior.

Though genera of posterior internal ophthalmia are above admitted, it must be confessed, that in practice choroiditis, retinitis, vitreo-capsulitis, and zonulitis are found so mixed up together that their special diagnosis would not help the treatment. The revelations of the ophthalmoscope do, as we have seen, little more than establish the existence of mischief at the bottom of the eye,—involving in one case, perhaps, the choroid principally; in another, the retina; and in a third, both equally. Besides, many of the ophthalmoscopical appearances indicate morbid alterations of structure,—the effects of past inflammation.

There are no marked objective symptoms, as distinguished from ophthalmoscopical characters, whereon to found a differential diagnosis between choroiditis and retinitis for example.

As to subjective symptoms, again, though there is reason to believe that photopsy is owing to pressure on the retina by an inflamed choroid, and dimness of sight alone occasioned by retinitis, these symptoms can scarcely be admitted as pathognomic, because they often coexist; whilst pain appears to be dependent rather on the acuteness of the inflammation, and the degree to which other parts besides the choroid and retina may have become implicated, as above observed.

Notwithstanding the advance which has been made in the critical diagnosis of choroiditis, retinitis, &c., considered as genera of posterior internal ophthalmia, by means of the ophthalmoscope, all that is really of importance practically, is to discriminate certain forms of posterior internal ophthalmia, characterised principally by the degree and effects of the inflammation, and by the state of the constitution, or by the constitutional disease with which the ophthalmia appears to be connected.

The principal forms of posterior internal ophthalmia met with, in respect to degree and effects of the inflammation, are—

1st.—*Posterior internal ophthalmia, with serous effusion.*
2nd.—*Posterior internal ophthalmia, with plastic exudation.*
3rd.—*Posterior internal ophthalmia,—the inflammation especially involving the optic nerve.*

The principal forms of posterior internal ophthalmia in respect to the state of the constitution, or the constitutional disease with which the inflammation appears to be connected, are—

4th.—*Scrofulous posterior internal ophthalmia.*
5th.—*Syphilitic posterior internal ophthalmia.*
6th.—*Arthritic posterior internal ophthalmia.*

1st.—*Posterior internal ophthalmia, with serous effusion.**

External objective symptoms.—The lens and iris are inclined towards the cornea, so that the aqueous chamber is diminished in depth,—a state of parts which is owing to pressure from behind occasioned by the congestion of the choroid and retina, and the serous effusion consequent thereon, especially the increased accumulation of vitreous fluid. Inclination of the iris towards the cornea is, therefore, a manifestation of congestion and serous effusion in the posterior segment of the eye.

Another manifestation is distention and hardness of the eyeball.

Congestion is usually not confined to the posterior segment in such cases, for, on examination, we find that the conjunctiva and sclerotica, besides being pervaded by enlarged and tortuous recto-muscular vessels, are otherwise not so free from vascularity as they should be.

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* Choroiditis serosa.—Retinitis serosa.

The pupil is at first sluggish, partly in consequence of the pressure on the iris, and partly in consequence of the accompanying impairment of the sensibility of the retina. In a later stage, the iris may appear dull and discoloured, and the pupil more or less dilated and fixed.

Subjective symptoms. — The characteristic subjective symptom is amblyopia, or impairment of sight, which may or may not be accompanied by increased sensibility to light, muscæ volitantes, and photopsy. In some cases there is both ocular and circumorbital pain; but usually no pain is complained of, though there is an uneasy feeling of distention in the eyes.

An attempt to exercise the sight, in reading or the like, brings on pain, heat, increased redness, intolerance of light, and lacrymation.

At other times, the eyes may feel dry.

The disturbance of sight sometimes comes on almost imperceptibly; sometimes it manifests itself suddenly, accompanied by pain in and around the eyes, with, perhaps, nausea and vomiting. The severity of such an attack may pass off, but the sight does not recover its former strength, and, notwithstanding occasional intervals of improvement, gradually becomes more impaired, so that small, distant or ill-illuminated objects are indistinctly or not at all seen. Under such circumstances, convex glasses help the sight by magnifying the objects, which, of course, require to be held near.

Causes.—Posterior internal congestion of the eyes will generally be found to coexist with abdominal, hepatic, or hæmorrhoidal congestion. It is common at the turn of life. In persons thus predisposed, exposure to too strong light, general debilitating influences, over-exertion of the sight, or the like, readily operate as an exciting cause of posterior internal ophthalmia.

Diagnosis.—This is founded on the ophthalmoscopical appearances, taken in conjunction with the symptoms above described.

Under the ophthalmoscope, we may observe increased injection of the small vessels of the papilla optica and retina, the central veins much distended, and the corresponding arteries constricted,—a dull appearance of the retina itself, and the choroid shining through dark red. Small extravasations of blood may present themselves.

In a later stage, increased deposition of stromatic pigment obscures the smaller choroidal vessels, so that the larger only are seen with dark intervening spaces;—the papilla optica is whitish, the retina beset with pigment deposits;—and the central vessels, perhaps, somewhat shrunk in size.

Sometimes the vitreous body is so dim that the state of the fundus cannot be well seen.

Prognosis.—Congestion of the choroid and retina is of a chronic character. As an effect, various deteriorations of structure supervene, and the sight eventually becomes more and more impaired.

Treatment.—Abatement of the exciting cause,—rest to the eyes,—attention to the liver and bowels,—general tonic and alterative medication.

Locally, bathing the eyes with cold water. In intense congestion, leeches; and, as a last resource, iridectomy.

2nd.—*Ophthalmia interna posterior, with plastic exudation.**

The *external objective symptoms*, and the *subjective symptoms*, are similar to those in the preceding case, only more marked and severe.

Diagnosis.—Ophthalmoscopic examination reveals exudations of lymph on the inner surface of the choroid, in the form either of opaque patches or disseminated points. Around the exudations, pigment deposits are seen.

Opacity obscuring the boundary between the pupilla and retina and extending in the course of the retinal vessels, indicates exudation in those parts.

Patches of extravasation of blood may present themselves.

Prognosis.—This inflammation runs a chronic course, but is subject to exacerbations which are attended by severe pain in and around the eye, intolerance of light and lacrymation, photopsy, with increasing deterioration and circumscription of sight.

Treatment.—Mercurialization is here required, aided in some cases by abstraction of blood, and afterwards counter-irritation.

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* Choroiditis exudativa.—Retinitis exudativa.

3rd.—*Posterior internal ophthalmia,—the inflammation especially involving the optic nerve.*[*]

Of this inflammation, which often depends on intracranial or intraorbital disease, on some general dyscrasy, or on extension from the retina, there are no external objective symptoms.

The characteristic subjective symptom is impairment of sight, with circumscription or interruption of the field.

The diagnosis is founded on the opthalmoscopic appearances which have been above indicated at pp. 53, 54, 127, 128.

An effect of inflammation of the optic nerve we have seen is atrophy of the papilla, which is manifested by a white tendinous aspect, and sometimes by an excavation of its surface, arising in part from the coexistent intraocular pressure. The annexed figure is a diagram of a section of an excavated papilla.

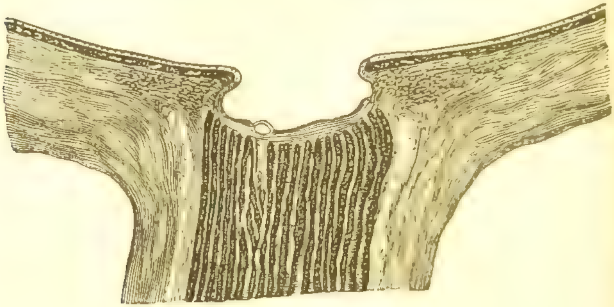

Fig. 39.

Treatment.—When the inflammation depends on intracranial or intraorbital mischief, or on some general dyscrasy, its treatment is of course a very secondary consideration to that of the general disease.

When the inflammation forms a part merely of a posterior internal ophthalmia, the general treatment above indicated is that which is applicable.

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[*] Neuritis optici.—Neuritis optica.

4th—*Morbid alterations of structure,—effects of posterior internal ophthalmia.*

Detachment of the retina from the choroid by serous effusion between the two membranes.

Adhesion between the retina and choroid by exudation of lymph from the inner surface of the former.

Atrophy of the choroid and sclerotic staphyloma.

Degeneration of the papilla and retina.

Softening and opacities of the vitreous body.

For a detailed account of these morbid conditions, see above at pp. 48, 52, 124, *et seq.*, and below, under the heads of the Morbid states,—accompaniments or consequences of the Ophthalmiæ,—Sclerotic staphyloma,—Atrophy,—Glaucoma,—Amaurosis, &c.

5th.—*Scrofulous posterior internal ophthalmia.*

Dimness of vision in a greater or less degree is the symptom which generally first seriously attracts attention. Fixed muscæ, photopsy, headache, intolerance of light, may or may not be precursors or accompaniments.

Objective symptoms.—When, in consequence of these subjective symptoms, an examination of the eye is made, it will probably be found that the pupil is dilated and sluggish or immovable, and its margin adherent by bands of lymph to the capsule of the lens. It will perhaps also be found that there is some external redness in the form of a sclerotic circumcorneal blush, which, together with the state of the iris and pupil, is a manifestation of the supervention of anterior internal ophthalmia.

In addition to these appearances, it will perhaps be observed that the sclerotica is attenuated and dark-coloured, and that the white of the eye is pervaded by enlarged and tortuous recto-muscular vessels, ramifying towards the cornea. The cornea itself, perhaps, presents minute points of opacity.

The eye may never undergo any further change than what is above described.

In some cases, on the contrary, especially after repeated acute attacks, manifested by actual inflammation of the sclerotica (p. 110), the latter membrane, in some part of its extent, becomes more attenuated and darker coloured, and bulges out here and there, along with the atrophied choroid, forming sclerotic staphyloma. A staphylomatous bulging often presents itself over the region of the ciliary body.

Towards the side next the sclerotic staphylomatous projection, the pupil may be displaced, and on the same side patches of opacity frequently present themselves in the cornea.

The iris is sometimes little, sometimes much, implicated; in the latter case it is degenerated in structure and bolstered towards the cornea.

Subjective symptoms.—In the course of these changes, in addition to the dimness of vision and photopsy, &c., there is pain over the eyebrow and in the temple as well as in the eye. Eventually vision becomes dimmer and dimmer until it is entirely lost.

In this stage of scrofulous posterior internal ophthalmia, remissions and exacerbations of the inflammation occur. During an exacerbation, the white of the eye is of a purple colour, from the blending of the dark tint of the attenuated sclerotica and the red colour of the injected vessels. There is very severe pain in the eyeball, in and around the orbit, and over the whole side of the head, with intolerance of light and lacrymation.

Constitutional symptoms.—To these local symptoms is added considerable constitutional disturbance.

Causes.—This form of posterior internal ophthalmia is met with principally in young adults of scrofulous constitution, more frequently females than males, and is commonly attributable to overuse of the eyes, with neglect of exercise, derangement of the stomach and bowels, disturbed menstruation, &c. Traumatic inflammation of the eye sometimes takes this form.

Diagnosis.—This may be inferred from what has been above said. The inflammation appears to be a sclerotico-choroiditis implicating the retina secondarily.

Prognosis.—The prognosis, as regards vision, is unfavourable; in the more advanced stage very much so. Still it does sometimes happen that the disorganizing progress of the inflammation is arrested, and some degree of vision preserved or restored.

Treatment.—If the case be seen early, abstraction of blood by leeches, in number according to the strength of the patient, free action on the bowels, and mercury pushed so as to affect the gums, constitute the proper treatment.

In the more advanced stages of the disease, the tonic and alterative treatment—the bichloride of mercury, in doses of one-thirtieth to one-sixteenth or one-eighth of a grain, three times a day, in tincture of bark; or the arseniate of potass, in doses of one-thirty-secondth of a grain, either in the form of Fowler's solution or in that of a pill—with counter-irritation, should be tried. The abstraction of blood by leeches may still occasionally be necessary.

During an exacerbation of the inflammation, the belladonna or atropia lotion (p. 80) is an excellent application to the eye. Under its use alone I have seen the inflammation diminish, and the pain and intolerance of light rapidly relieved.

6th.—*Syphilitic posterior internal ophthalmia.**

Iritis, we have seen, is the most common form of syphilitic internal ophthalmia, but the inflammation is very liable to spread to the ciliary body, choroid, retina, and sclerotica. The retina may lose its sensibility, and he choroid and sclerotica become staphylomatous. Eventually the eyeball may fall into a state of atrophy.

Sometimes, on the other hand, the posterior tunics are the parts first and chiefly affected, the iris only becoming implicated secondarily. Sometimes the iris does not become affected at all.

Whilst syphilitic iritis is of a more or less acute character, syphilitic posterior internal ophthalmia observes a more chronic but still more destructive course. Sometimes one eye only is affected, though usually both are so.

In cases of syphilitic posterior internal ophthalmia in which iritis supervenes, the pupil is dilated, and while its centre is still black, the pupillary edge of the iris is the seat of deposits of lymph and adhesions to the anterior wall of the capsule of the lens.

The external redness in such a case is the redness of the supervening iritis.

Under the ophthalmoscope, small white patches of exudation, surrounded by a reddish-brown border, may be observed disseminated in great number over the fundus. That these patches are seated behind the retina nd on the inner surface or in the substance of the choroid, is evident from the circumstance that the retinal vessels are seen ramifying over them.

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* Syphilitic amaurosis.

The optic papilla and retina are the seat of dull, diffused opacity, from exudation, extending in the direction of the central vessels, and, in a variable manner, around the macula lutea. This diffuseness of the retinal opacity forms a striking contrast with the well-defined opacity characteristic of the fatty degeneration of the retina met with in Bright's disease. See fig. 18, p. 56.

Extravasations of blood may also present themselves.

In an advanced stage, the choroid is found atrophic. That the retina and optic papilla have become atrophic also is manifested by the shrunken state of the latter and the small size or even obliteration of the central vessels.

The vitreous humour may be found cloudy or in a dissolved state, with filaments and floccules undulating in it.

After the first outbreak of the disease, the morbid process at the bottom of the eye with the corresponding impairment of sight proceeds slowly—with or without remissions. There then takes place, suddenly perhaps, a further obscuration of the centre of the field. But any time in the course of the disease, sudden blindness may be occasioned by retinal hæmorrhage and infiltration of the vitreous body. The extravasated blood may in the course of some weeks be absorbed, but hæmorrhage still more extensive is liable again to supervene.

Treatment.—As the subjects of this form of posterior internal ophthalmia in general labour under a syphilitic dyscrasy, the treatment must be tonic and alterative. A course of the corrosive sublimate of mercury in doses of one-sixteenth to one-eighth of a grain, with tincture of bark and decoction of sarsaparilla, two or three times a day, may be prescribed, and after that the iodide of potassium, with or without iron, according to the circumstances of the case.

We have above seen (p. 199) that in parenchymatous corneitis, which almost always has its root in a hereditary syphilitic taint, the posterior tunics are liable to become involved in the inflammation with amaurotic symptoms.

It is here to be observed that in young persons presenting the same indications of a hereditary syphilitic taint posterior internal ophthalmia is sometimes met with ndependently of any preceding attack of corneitis or ritis.

The plan of treatment in such cases is the tonic and lterative.

Infants who have manifested symptoms of hereditary yphilis, such as are above mentioned at p. 225, are someimes affected with a posterior internal ophthalmia.

There may not be or have been any external indications f inflammation.

The attention of the mother has been attracted to the yes, solely on account of the infant rolling them about, nd appearing not to notice.

On examination, I have observed in the few such cases f the kind which have come under my notice, a yellowish eflection from the bottom of the eye, somewhat like that n incipient encephaloid. This has appeared under the phthalmoscope to be owing to lymph exuded on the surace of the choroid.

By the exhibition of mercury, in the manner above ndicated in the case of syphilitic iritis in infants (p. 225), ogether with cod-liver oil, some improvement has been ffected. But I have never had a case sufficiently long nder observation to see the ultimate result.

7th.—*Arthritic posterior internal ophthalmia.*

This disease occurs both in an acute and in a chronic orm. The acute form may supervene on the chronic, or ome on all at once. The chronic form usually comes on f itself, unpreceded by the acute form.

The acute differs from the chronic disease principally in he greater rapidity with which it leads to the organic hanges, causing destruction of the function of the eye,—ision being destroyed in the course of a few days, someimes even in a single night; and in a correspondingly reater severity of the subjective symptoms.

Keeping in view the difference in the rapidity of their ourse, the following description of the objective symptoms applicable to both the chronic and the acute form; but s regards the subjective symptoms, it will be necessary give a separate description of them, both as they occur the chronic, and as they occur in the acute form.

Objective symptoms.—The most characteristic of these at rst is, the state of the pupil, which is sluggish or fixed, and dilated. Instead of being circular, it is sometimes of an oval shape;—the long diameter being transverse, or vertical, or diagonal—most commonly transverse. The pupillary margin of the iris is bordered with pigment.

A dimness is seen through the dilated pupil, and, on careful examination, this is discovered to be owing to that peculiar deep-seated green opaque appearance of the lens called *glaucoma*. See *Glaucoma*.

The white of the eye, dark and dirty looking, is at first pervaded merely by large livid tortuous vessels derived from the recto-muscular; but, the congestion implicating the iris, the white of the eye becomes the seat of vascular injection, conjunctival as well as sclerotic, partially or completely round the cornea, though separated from it by the bluish-white ring above referred to (pp. 22, 23). The resulting redness is of a livid tint.

The iris, which was at first merely dull looking, becomes changed in colour, pervaded by varicose vessels, its pupillary margin retracted, its middle part inclined towards the cornea. There is no exudation of lymph.

The cornea may become dim and rough on its surface, like ground glass.

The eyeball is hard to the touch.

The sclerotica becomes attenuated here and there, and perhaps bulges out, constituting sclerotic staphyloma.

The lens may become cataractous (glaucomatous cataract), and, protruding through the dilated pupil, sometimes presses against the cornea.

Subjective symptoms of the chronic form.—Considerable dimness of vision, with photopsy, attracts the patient's attention, but so far from having intolerance of light, the patient sees best in good light. There may be at first no pain, at the most, uneasiness in the eyes; but in the progress of the disease a feeling of distension in the eyeball and occasional paroxysms of dull supra-orbital or circum-orbital pain, distress the patient.

Bodily exertion, or mental excitement, or errors of diet, aggravate; rest and mental tranquillity, and moderate nutritious diet, mitigate the symptoms.

Diminution of vision goes on, sometimes gradually, sometimes suddenly, the photopsy at the same time increasing, and continuing even after vision is lost.

Subjective symptoms in the acute form.—Severe burning, bursting pain in the eyeball, and racking pain in the supra-orbital or circum-orbital region, in the temples, and from thence extending over the whole side of the head. The pains are severest towards midnight.

There is much intolerance of light, accompanied by lacrymation, and the sensation as if a foreign body were in the eye.

With great photopsy, vision rapidly becomes dimmer and dimmer, until all sensibility to external light even is lost, though the photopsy may still continue.

General symptoms.—In the chronic disease the system does not sympathise much, but the occurrence of an acute attack is often ushered in by nausea and vomiting, with severe inflammatory fever.

Predisposing causes.—This disease occurs in persons advanced in life—more frequently females than males—and who have not been previously quite healthy, having been perhaps the subjects of irregular gout, derangement of he digestive organs, piles, headaches, gutta rosacea, or the like.

In such persons the eyes have seldom remained altogether sound; the borders of the eyelids are swollen and pervaded by large vessels; the white of the eye is dark and dirty looking, and pervaded by large varicose vessels derived from the rectal, filled with dark blood, the iris nclined towards the cornea, with the pupil rather large and sluggish, whilst a sensation of fulness is experienced n the eyeball. Photopsy and temporary dimness of vision are apt to be occasioned by stooping, by being heated, &c.

Exciting causes.—In persons in the state of general health, and with the state of eyes above described, ophhalmic inflammation, induced by any common occasional ause, is prone to assume this form.

As more special causes may be mentioned, suppressed gout, anxiety and mental distress, suppression of hæmorhoidal discharge, in the female the cessation of menstruation, the suppression of any other habitual discharge, continued over-exertion of the eyes, strong light, cold.

Both eyes may be attacked at once, but the inflammation is more severe in the one than the other. More usually one is first attacked and vision destroyed, and afterwards the other. One eye may however be spared.

Nature of the disease.—Great venous congestion, espeally of the choroid and retina, is the characteristic condition of the eye on which this ophthalmia supervenes.

Under the ophthalmoscope, when the eye can bear the examination, the excavated state of the optic papilla and peculiar course of the retinal vessels above described, and delineated at p. 54, may be observed, as also the constriction of the arteries and the enormous distension of the veins.

As an effect of the internal venous congestion, there is serous effusion, especially in the cells of the vitreous body, which, in part, causes the distension and hardness of the eyeball.

Arthritic posterior internal ophthalmia is identical with the affection named *acute glaucoma*. We shall therefore have to return to its pathology under the head of GLAUCOMA.

Cases.—The following is an example of the disease in a subacute form:—A woman, æt. 55, had been out of health and in a desponding state for three months, when one day in the early part of December she attended a funeral, and was exposed for a considerable time to the cold air. This was followed by an attack of inflammation of the right eye, and a fortnight after by a similar attack in the left.

There was both conjunctival and sclerotic injection. The surface of the cornea somewhat rough and dim. The iris inclined towards the cornea. Pupils dilated and irregular, and behind them a glaucomatous appearance.

The borders of the eyelids were red and swollen.

Impairment of vision and severe circumorbital pain were the subjective attendants on these objective phenomena.

After a fortnight's treatment, vascularity was much diminished, the sight improved, and pain all but gone. A week after this the report was, Quite free from pain—vision greatly improved.

In the course of the succeeding month, however, there were alternate relapse and improvement; and although all active inflammation subsided, and the general health improved considerably, congestion, and the dilatation of the pupils with the glaucomatous appearance behind them continued, and the sight, instead of getting better, gradually became worse.

The treatment under which the temporary improvement took place principally consisted of cupping to ℥vj.; ten grains of Dover's powder for some nights at bedtime—on two occasions combined with two or three grains of calomel—occasional laxatives, colchicum with magnesia, and afterwards a mixture of gentian with sulphuric acid. Friction with tincture of tobacco, and blisters to the nape of the neck and behind the ears, were applied.

The following is an example of a more acute attack:—A gentleman of active business habits consulted me one day respecting his eyes. He told me that he had recently had an attack of inflammation in them, and that he had at the same time been affected with nausea and vomiting. On examination I found the eyes congested, the pupils dilated and sluggish, and the sight still weak. By following my prescriptions and directions, the patient quickly recovered and returned home. Some weeks after, being in London on business, he called on me that I might see how well he had recovered. I warned him, however, not to consider his eyes safe, and advised him to be less eager after business. A few days after that, I was called to see him one morning. I found him in bed, with both eyes affected with severe arthritic posterior internal inflammation. He told me that he was seized the evening before with nausea and vomiting, that during the night he had been suffering excruciating pain in and around the eyes, and that he now found himself almost quite blind.

Although I explained to the patient the danger his sight was in, it was with great difficulty he could be induced to submit to the following treatment:—six leeches around each eye, calomel, colchicum, and Dover's powder, night and morning. Finding himself relieved, and his sight improved in two or three days, the patient refused to take any more medicine, and resolved, at the end of a week, contrary to my advice, to take a long journey home by rail.

He accordingly started one morning in an invalid carriage. His sight was then so far recovered that he could see to read a little; but in consequence of the fatigue and excitement of the journey, his eyes again became inflamed before reaching home, and next morning he was quite blind of both eyes, and continued so.

In the following case, first one eye and then the other was destroyed.

In a woman, about fifty-seven, the right eye was affected severely as above described (pp. 241, 242); the white of the eye pervaded by tortuous vessels, the cornea dim and rough, the pupil dilated and fixed, the lens glaucomatous and cataractous, and the eyeball hard to the touch, while vision was completely abolished. The left eye was in the state of predisposition above indicated. A new and severe attack of inflammation, attended by the subjective symptoms described in p. 242, supervened in the right eye, the consequence of which was that the cornea became infiltrated with matter, and at last gave way, allowing of partial evacuation of the humours, so that the eyeball shrank to a stump in the socket, with relief to the suffering. But inflammation supervening in the left eye, though with milder symptoms, vision in it was soon completely annihilated. On examination, the pupil was seen much dilated, and the lens glaucomatous.

Diagnosis.—This disease during its active state is to be distinguished from arthritic anterior internal ophthalmia (p. 226, et seq.), and the state in which the eye is left by it must be distinguished from cataract and amaurosis properly so called.

Prognosis.—From the cases above related, it will be seen how unfavourable the prognosis is.

Treatment.—The application of leeches, two grains of calomel with one of extract of colchicum and five or ten of Dover's powder, at bedtime for several nights, and free action on the bowels, I have frequently found beneficial in checking the inflammation. After that, counter-irritation and tonics have proved useful.

In many cases, however, no effectual relief is obtained from this treatment.

Under such circumstances iridectomy (p. 151), is to be had recourse to. If the inflammation has already attained a severe degree, the operation had better be performed at once.—See further on this subject under the head of GLAUCOMA.

Order IV.—PANOPHTHALMITIS.

Panophthalmitis is inflammation of the whole eye. Primary panophthalmitis, *i. e.*, inflammation invading the whole eye at once, is of rare occurrence. Most commonly, panophthalmitis is secondary, being developed by extension of inflammation from one structure to another, as has been seen may take place in some of the ophthalmiæ above considered, especially the posterior internal, and sometimes in the severest degree of purulent ophthalmia.

As has been above said, panophthalmitis is genus as well as order.

Genus.—PANOPHTHALMITIS.

The species or form of panophthalmitis which it is purposed to consider here is phlegmonous panophthalmitis.

Certain other forms will be treated of below, in the Appendix to this section.

*Phlegmonous panophthalmitis.**

Objective symptoms.—The eyelids are red and swollen, especially the upper. There are inflammatory swelling of the cellular tissue of the orbit and capsule around the eyeball, and chemosis of the conjunctiva. The chemotic swelling is not so great around the cornea, as at the circumference of the eyeball. In consequence of this, the eyeball is fixed and protrudes from the orbit, stretching the upper eyelid and depressing or everting the lower.

The chemosed conjunctiva is covered with a pseudomembranous formation.

Besides hypopyon, a collection of matter in the form of a yellowish-brown opacity is seen deep in the vitreous humour, if the cornea and lens have not already become opaque.

Subjective symptoms.—There are photopsy and blindness; and, as might be expected from the great distension of the eyeball from within, and the pressure to which it is subjected from without, the suffering is very severe. Besides the hot burning pain in the eyelids and the whole region of the eye, aggravated by the slightest touch or attempt at motion, there is deep distending throbbing pain in the eyeball as if it would burst, pain in the orbit extending to the back of the head, pain around the orbit, in the temples or all over the side of the head and face. There is also great intolerance of light, with lacrymation.

Constitutional symptoms.—Inflammatory fever and sometimes delirium accompany the disease.

Course.—To the symptoms of internal inflammation with pain there are soon added the swelling of the eyelids, the prominence of the eyeball, and the chemosis.

As the disease advances all the symptoms become aggravated, and suppuration is ushered in by a feeling of weight and cold in the eye, and general rigors.

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* Ocular phlegmon.—Idiopathic ophthalmitis.

In consequence of the accumulation of matter in its interior, the eyeball is much distended, and in consequence of the increasing effusion into the ocular capsule, it protrudes still more from the orbit. The cornea, at last, may become infiltrated with matter and slough.

With the supervention of suppuration the suffering not only does not abate, but actually increases, in consequence of the strong outer tunics of the eyeball not at first yielding to the distension from the accumulated matter. At last, however, the eyeball bursts by the ulcerated cornea or softened sclerotica giving way, and the abscess, together with blood and the humours of the eye, are evacuated. The pain which before this was of the severest character, is now at once greatly relieved, and afterwards, together with the inflammatory swelling of the parts, gradually subsides.

Sometimes it is merely the abscess of the ocular capsule which points and bursts; the eyeball remaining entire.

Implication of the membranes of the brain may supervene.

The disease is not always of so severe a character. The swelling of the eyelids and chemosis of the conjunctiva may be but slight, the orbital capsule little affected, tension or tenderness of the eyeball not great, photopsy and pain inconsiderable, fever moderate. Nevertheless, there is seen the dark-yellow collection of pus in the vitreous body, with more or less hypopyon.

Causes.—This disease of the eye usually occurs, especially in particular states of constitution, in consequence of the intense operation of those causes of ophthalmic inflammation in general which act directly on the eyes as above mentioned (p. 135), especially injuries, chemical or mechanical. Not unfrequently ocular phlegmon follows operations on the eye, such as cataract operations, abscission of staphylomata, and even iridectomy. Also extensive perforating ulceration of the cornea, as in the purulent ophthalmiæ. It is especially liable to occur when there has been much loss of vitreous humour.

Under such circumstances, as there is no great intraocular distension, the suffering may not be so very great as it is in cases in which there is at first no outlet to accumulated fluids.

Prognosis.—It is rarely the case that the eye can be saved as an organ of vision. When the disease has already made some progress, preservation of the form of the eye, though atrophic, will perhaps be all that can be hoped for. When suppuration has taken place, even this can no longer be calculated on. If the eyeball bursts, either by giving way of the sclerotica or destructive ulceration of the cornea, the humours will be evacuated along with the matter, the tunics will therefore collapse, and after cicatrization nothing of the eyeball will remain but a small stump at the bottom of the orbit. As the suppurative process may extend to the membranes of the brain, there is danger of life. In the milder forms, when the matter is not thus evacuated, it is absorbed, and the eye becomes atrophic, with the cornea still clear though small.

Treatment.—Blood-letting, mercurialization, and opiates—incision of the chemosed conjunctiva (p. 91), evacuation of the aqueous humour, belladonna lotion, and anodyne frictions around the orbit or over the temples, &c., constitute the treatment which must be carried into effect in the commencement of the acute disease. Subsequently, when suppuration threatens or has commenced, all that can be done is to apply a poultice; and when the abscess, whether of the eyeball or ocular capsule, becomes prominent at some point, to evacuate it by puncture with a lancet, in order to relieve the suffering. Puncture of the eyeball with a lancet may even be advisable before this, to relieve suffering by removing tension, and to obviate the danger of the inflammation extending to the brain. After this it will be necessary to support the system with generous diet and tonics.

When the eye has become quite disorganized, the pain still excessive, and especially if there is reason to suppose that there is a foreign body in the eye, the best practice is to proceed without delay to the excision of the eyeball from the ocular capsule.

Sometimes, especially in cases of injury, such as the lodgment of a foreign body in the eye, instead of suppuration, there may be effusion of blood and serum between the choroid and retina, with exudation of lymph in the region of the ciliary processes and iris. In such a case, also, it is best to excise the eyeball.

APPENDIX TO THE PRECEDING SECTION.

There are certain febrile and inflammatory diseases, viz., the exanthemata, hooping-cough, a particular form of epidemic fever, and phlebitis, in the course of or subsequent to which, inflammation of the eyes is liable to supervene. The inflammation is commonly named morbillous, scarlatinous, variolous, postfebrile, or phlebitic ophthalmia or ophthalmitis, according to the general disease with which it is connected. It is, however, to be observed, that in such cases the ophthalmia is essentially the same as some of the forms above described, being not only not a specific inflammation, but not even always of the same kind in different cases of the same general disease; thus, exanthematous ophthalmia is sometimes phlyctenular, sometimes puromucous, sometimes internal, sometimes even a panophthalmitis.

Whilst therefore the practitioner, in treating the general diseases above mentioned, must be prepared to encounter supervening ophthalmic inflammation, he must also be prepared to find that inflammation more or less different in kind in different cases of the same disease, and requiring, therefore, different modes of treatment—modes of treatment, however, not differing from those above indicated for the particular species or form of inflammation, except in so far as may be necessitated by the presence of the general disease.

Here a few remarks may be made on syphilis and the syphilitic inflammations of the eyes.

Syphilis is so far like an exanthema, such as the smallpox, that a person who has once been inoculated, and infected with the disease, is not liable to a new infection. But to counterbalance this immunity, the old infection clings to its victim in a very inveterate manner, showing itself often again and again in some shape or other long after he had supposed himself cured. The disease may descend to his children, and sometimes even infect, through the fœtus in utero, the previously healthy mother. Or, the father being healthy, a woman who has been once diseased, though reputed cured, may bring forth a diseased child. Such facts indicate that in the case of a diseased father it is the *seminal fluid*, and in the case of a diseased mother, it is the *ovum* which is contaminated through the blood.

The mischief does not even stop here. For hereditary syphilis is very contagious, and may be propagated from the sores on an infected infant to any person handling it, such as its nurse (provided that nurse is not its mother), who will in her turn infect any healthy infant whom she may afterwards suckle, or, indeed, any other person with whom she may happen to come into close contact.

From these remarks, the difference between acquired and hereditary syphilis will be understood. It is, however, to be remembered, that it is possible for an infant free from hereditary taint, to become infected with syphilis by inoculation from a hired wet nurse.

The forms of ophthalmic inflammation above described arising from hereditary syphilis are, syphilitic ophthalmia neonatorum, syphilitic iritis in infants, syphilitic posterior internal ophthalmia in infants, and parenchymatous corneitis in young persons; whilst those arising from acquired syphilis are, the common syphilitic iritis, and syphilitic posterior internal ophthalmia of adults.

1st.—*Morbillous ophthalmia.*

Morbillous ophthalmia is the inflammation of the eyes which occurs in or supervenes on measles, and which usually resembles common phlyctenular ophthalmia, though it sometimes assumes the scrofulo-catarrhal or puro-mucous character, or even runs into internal inflammation or panophthalmitis. In general the inflammation is mild, but phlyctenulæ, or even abscess of the cornea, followed by more or less destructive ulceration of it, may take place.

Diagnosis.—Morbillous ophthalmia at its commencement so much resembles scrofulous ophthalmia, that it might sometimes be taken for it before the general disease has declared itself by eruption. When this has taken place, the morbillous nature of the ophthalmia will, of course, also be evident, irrespective of any differences in its nature in other respects which may present themselves.

Prognosis.—Although, in general, this ophthalmia commonly subsides with the general disease, under very simple treatment, it should be as carefully watched as if t was an idiopathic affection. By neglect, very serious or irretrievable injury may take place by ulceration of he cornea, to the extent even of its destruction, and the ormation of staphyloma.

Measles are apt to leave behind them a tendency to ophthalmia, especially scrofulous ophthalmia, ophthalmia arsi, and blenorrhœa of the lacrymal passages.

Treatment.—The general treatment necessary for the general disease answers for that of the ophthalmia. Tonics may be necessary to promote convalescence.

The local treatment of the inflammation of the eye is to be conducted on the principles laid down for the idiopathic ophthalmia which it may more particularly resemble.

2nd.—*Scarlatinous ophthalmia.*

Inflammation of the eye, occurring in scarlet fever, is, in general, similar to morbillous ophthalmia, and the treatment is to be conducted on the same principles.

I have more frequently found iritis occur in scarlet fever.

The ears as well as the eyes are liable to suffer from inflammation in both measles and scarlet fever. In the latter disease the inflammation is especially destructive of the ears, and sometimes also of the eyes.

3rd.—*Variolous ophthalmia.*

This is generally of a much more severe and dangerous character than the other exanthematous ophthalmiæ, as used to be exemplified with such lamentable frequency before the introduction of vaccination.

Variolous ophthalmia most commonly puts on a form resembling scrofulo-catarrhal ophthalmia, with more of the phlyctenular than catarrhal characters (p. 205), or catarrho-rheumatic ophthalmia. Sometimes it is a purulent ophthalmia. Sometimes the internal tunics are implicated, or the case runs into ophthalmitis.

It is about the eleventh or twelfth day or later from the first appearance of the eruption, and when the secondary fever has commenced, that the ophthalmia most commonly comes on.

There is conjunctival and sclerotic redness, accompanied by heat, pain, and the sensation as if a foreign body were in the eye, and intolerance of light, with lacrymation. Exudation takes place into the substance of the cornea: pustules or abscesses form and burst, and by the extension of the ulceration which supervenes, the cornea may be penetrated or destroyed to a greater or less extent.

When the disease puts on the form of purulent ophthalmia, this unfortunate result is still more apt to ensue.

The period of invasion of this ophthalmia being when the general eruption is on the decline, the pustules or small abscesses which are so apt to implicate the cornea, ought not, Drs. Gregory and Marson justly insist, to be viewed as of a specific nature, like the pustules of the skin, but merely of the same nature as those which may occur in any acute external ophthalmia.

In the eruptive stage of small-pox there may be some degree of conjunctivitis, but this is neither frequent nor dangerous. When there are many pustules on the eyelids and their margins, indeed, the swelling may be so great that the eyelids cannot be opened, and there may be an increased Meibomian secretion, by which the edges of the eyelids are glued together and the eyelashes encrusted; but there is not much lacrymation, little or no pain in the eye, or manifestation of intolerance of light; and when at last, on the fading of the eruption and subsidence of the swelling, the eyelids admit of being opened, the eyeball is found quite safe, the conjunctiva perhaps being merely somewhat injected, and the seat of a little increased mucous secretion.

Small-pox, like scarlet fever and measles, leaves behind a tendency to phlyctenular ophthalmia, scrofulo-catarrhal ophthalmia, ophthalmia tarsi, blenorrhœa of the lacrymal passages, &c.*

Treatment.—As a prophylactic measure during the eruptive stage, any matter which collects at the borders of the eyelids is to be frequently washed away by means of tepid water, and after each ablution some mild ointment is to be smeared along the borders of the eyelids.

Ophthalmia having declared itself, the plan of treatment must be that adapted to the particular form which it has assumed.

When the cornea is threatened, vinum opii, dropped into the eye every day or every other day, is a most important part of the treatment.

When the inflammation has begun to abate, tonics and generous diet will be useful. If the system of the patient be in an exhausted state, good diet, cordials, and tonics, as far as they can be pushed, will be necessary from the first.

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* In small-pox, not only is a tendency left to phlyctenular ophthalmia, blear-eyes, disease of the lacrymal passages, &c.; but the eye-lashes are often partly lost, and partly turned in against the eyeball. The injury which may result to the eyelids from bad cicatrices is considered under the head of diseases of the eyelids.

When the cornea is opaque, perforated by the ulceration or altogether destroyed, the prognosis and treatment of the case come under the heads of *opacities of the cornea*, *prolapsus iridis*, or *staphyloma iridis*, which see.

4th.—*Postfebrile ophthalmitis.*

A remittent fever, sometimes attended with petechiæ, but not with the measly eruption of typhus, often accompanied with jaundice, its first paroxysm coming to a crisis within seven days, a relapse happening almost invariably, but the patient rarely suffering more than two paroxysms, and the mortality not exceeding three and a-half per cent., which prevailed very extensively in Edinburgh and Glasgow in 1843-4, and has prevailed at different times in Dublin, was liable to be followed by various sequelæ, of which the most remarkable was the affection of the eye to be here noticed.

This disease appears to be a form of posterior internal ophthalmia, usually but not invariably with extension of the inflammation to the anterior segment of the eyeball.*

Symptoms.—At a period, varying from a fortnight to five or six months, after recovery from the fever, the posterior internal ophthalmia declared itself by the subjective symptoms of muscæ volitantes, and more or less dimness of vision, increasing perhaps until merely a perception of light and shade remained. When anterior internal ophthalmia was superadded to the posterior internal, attention was more forcibly drawn to the disease, not only by the inflammation having become objectively evident, but by the accompanying ocular and circumorbital pain.

The greatest number of cases of this ophthalmia occurred in young adults. One eye alone was more commonly affected than both. Of the two eyes the right appears to have been the one which more frequently suffered.

Exciting cause.—The onset of the disease of the eye was generally traceable to some such exciting cause as exposure to cold, using the eyes too early after recovery from the fever, &c.

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* In some cases, the inflammation of the eye arose in and was confined to the anterior segment, being an anterior internal, or sometimes merely an external ophthalmia. There were therefore no amaurotic symptoms.

Prognosis.—When early and properly treated, the disease was in general found to yield completely though slowly; vision being restored even when it had become already extinguished. When not thus treated, or altogether neglected, irremediable sequelæ were found to remain, such as imperfect vision, muscæ volitantes, sclerotic staphyloma, opacity in pupil, &c.

Treatment.—Bleeding, mercury, and belladonna at the commencement; and when the acuteness of the disease began to subside, counter-irritation and quina, appear to have constituted the most successful treatment. Though the patients laboured under general debility at the time, it was nevertheless found that unless abstraction of blood was had recourse to, the recovery was slow and imperfect.*

5th.—*Phlebitic ophthalmitis.*†

This is a panophthalmitis occurring in cases of phlebitis, traumatic, puerperal, or of other origin.

In some cases the inflammation comes on slowly, and does not cause much distress to the patient; in other cases, the attack is sudden, and is attended by very severe symptoms. In either case, however, supposing the patient does not sink under the primary disease, the eye is either destroyed by suppuration and bursting of the abscess, or left amaurotic and atrophic.

One eye or both may be affected.

The constitutional spmptoms which attend this disease are those of the phlebitis, which are of a typhoid character.

The general circumstances of the case distinguish phlebitic ophthalmitis from common phlegmonous panophthalmitis, to which, as regards local symptoms, it has, especially in its acuter form, a great resemblance. There is a difference in the appearance of the chemosed conjunctiva, which in phlebitic ophthalmitis is whitish instead of bright red. An exudation of lymph, in the form of a pseudo-membrane, on the surface of the conjunctiva, may occur in both diseases.

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* For detailed accounts of Postfebrile Ophthalmitis, as it occurred in Glasgow, see the papers of Dr. Mackenzie in the "Medical Gazette" for Nov. 1843, and of Dr. Anderson, in the 'London and Edinburgh Monthly Medical Journal" for October, 845. Also Dr. Mackenzie's "Practical Treatise on the Diseases f the Eye." 4th edition, 1854.

† Pyæmic ophthalmitis.

Treatment.—Considering the grave nature of the primary disease, the affection of the eye constitutes but a comparatively secondary consideration in the case. The general treatment proper for the phlebitis is that which is also proper for the ophthalmitis. The local treatment should be much the same as that above indicated for phlegmonous panophthalmitis.

6th.—*Traumatic and sympathetic ophthalmitis.*

Inflammation of the eye excited by injury puts on one or other of the various forms above described. The particular form of ophthalmia excited depends partly on the seat and degree of the injury, and partly on the age, constitution, and state of health of the patient. The influence of constitution and state of health, for example, is shown by the circumstance that a similar injury may give rise to a severe internal ophthalmia in one person, whilst in another it may occasion a comparatively unimportant external inflammation.

The general treatment of traumatic ophthalmia must be conducted on the same principles as that for the corresponding forms of ophthalmic inflammation above described.

The special treatment in individual cases will be spoken of below, under the head of Injury of the different parts of the eye.

In certain cases, the eye injured does not alone become inflamed; the opposite eye ere long becomes affected also, and suffers as much, sometimes even more. This is considered owing to the sympathy which exists between the two eyes, and hence the inflammation supervening in the uninjured eye has been named *sympathetic ophthalmia.*

The traumatic ophthalmia on which sympathetic inflammation of the opposite eye is most apt to supervene, involves the internal textures of the eyeball, posterior as well as anterior; and the injuries which most commonly excite this degree of internal inflammation, are penetrating and lacerated wounds in the region of the ciliary body, especially with some loss of vitreous humour, and prolapse of the iris, inflicted by cutting instruments, or by the forcible projection of splinters of iron or stone, or the fragments of percussion caps.

The sympathetic ophthalmia in like manner involves the internal textures, more especially those of the posterior segment of the eyeball; hence diminution of vision and photopsy are early symptoms.

The period of time after injury of one eye, at which the sympathetic ophthalmia supervenes in the other, is generally five or six weeks, but sometimes much later. Indeed, after a severe injury of one eye, the opposite eye is liable to suffer at any time.

Though the subjects of sympathetic ophthalmia are apparently healthy at the time of the original accident, they do not in general appear to be of sound constitution, for their health readily breaks up under the treatment necessary for the traumatic ophthalmia, and the debilitated state of health thus induced is, perhaps, one of the conditions which operate in predisposing to the sympathetic ophthalmia.

The sympathetic attack sometimes cannot be traced to any immediate exciting cause; sometimes it appears to have been brought on by using the eye too soon after the injury of the opposite eye.

The wounded eye in general becomes atrophic and amaurotic, and the sympathetically affected one pretty certainly shares the same fate, in spite of the most carefully conducted and appropriate treatment.

Sympathetic ophthalmia having hitherto proved so little amenable to treatment, the greatest attention should be paid to every case of traumatic internal ophthalmia, however slight apparently at first, in the hope of obviating an attack of sympathetic ophthalmia. And after the cessation of the traumatic ophthalmia, especial care should be taken by the patient not to use either eye much for a considerable time to come.

It has been supposed that injuries attended with the lodgment of a foreign body in the interior of the eye, are those especially which are followed by sympathetic inflammation. This is, however, not always the case, for the inflammation has been found to occur in cases of injury of the eye in which there could be no suspicion that any foreign body had become lodged in its interior, and sympathetic ophthalmia does not always supervene in cases of injury of one eye, even when it is certain that a foreign body is lodged in its interior.

On the supposition, however, that the presence of a foreign body in one eye is the cause of supervening sympathetic ophthalmia in the other, Mr. Barton, of Manchester, recommended abscission of the anterior segment of the injured eye, and the application of a poultice over it, leaving the foreign body to come away with the discharge,—which it usually does in a day or two after. In the healing process, the tunics of the eyeball close in, and a stump remains, fit for the support of an artificial eye, as after the operation for staphyloma.

That the practice just described has appeared to ward off sympathetic ophthalmia from the other eye, constitutes good ground for adopting the same plan even in cases in which there is certainly no foreign body lodged in the interior of the eye, but in which the injury is in other respects similar, and has already destroyed vision, and in which sympathetic ophthalmia threatens.

A more trustworthy and satisfactory practice, however, is to excise the whole of the injured eye from the ocular capsule.* After which, as we shall see below, a sufficiently good socket for the reception of an artificial eye may still remain.

SECTION IV.—CHRONIC INFLAMMATIONS AND VARIOUS OTHER MORBID STATES OF THE EYE, ACCOMPANIMENTS OR CONSEQUENCES OF THE OPHTHALMIÆ.

1st.—*Granular conjunctiva.*†

This morbid state of the conjunctiva of the eyelids, palpebral sinuses, and semilunar fold, presents an appearance something like that of a granulating sore (Plate I., fig. 2), hence the name; but its nature is altogether different, as has been above explained (p. 107).

The ocular conjunctiva is not subject to the disease. Any granular appearance which it may present either over the sclerotica or cornea is owing to real granulations.

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* See *infra*. Excision or enucleation of the eyeball.

† Granular eyelid.—Trachoma.

In consequence of the great tendency to granular conjunctiva in the puromucous ophthalmiæ (pp. 162, 164, 165), the surgeon should never allow himself to omit the examination of the inside of the eyelids and palpebral sinuses after the subsidence of those inflammations; for, although the sclerotic conjunctiva may have become free from redness, the palpebral will still be in the morbid state under notice (p. 163).

Granular conjunctiva is often found even in cases in which the sclerotic conjunctiva has not been much, if at all, involved in the inflammation, for, as above shown, the inflammatory congestion on which the development of granular conjunctiva depends, may never reach beyond the palpebral conjunctiva, and may be so slight as scarcely to have attracted the patient's attention (p. 165). On this chronic inflammation, however, an acute attack of ophthalmia from slight causes (p. 168), is liable to supervene.

Superficial vascularity, thickening, and opacity of the upper half of the cornea often exist along with granular conjunctiva, and have been attributed to the friction exerted on it by the rough surface. This does not, however, appear to be exactly the case, for vascularity, thickening, and opacity of the conjunctiva corneæ are met with in cases in which granular conjunctiva does not exist, and may be absent in cases in which granular conjunctiva is much developed. The morbid condition of the cornea just mentioned is rather the result of the extension of the same inflammation which first gave rise to the granular conjunctiva, though there can be no doubt that it is kept up and aggravated by the friction exerted by the granular surface of the palpebral conjunctiva (p. 169).

Prognosis.—Granular conjunctiva is a very intractable disease. Even under the most favourable circumstances, the conjunctiva is long of regaining, if it ever regains, its natural state.* Besides, the attending chronic inflammation is always ready to become aggravated into a more or less acute attack of purulent ophthalmia.

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* In Ireland, ophthalmia, with granular conjunctiva, and all its train of disastrous effects on the sight, appears to be endemic. Almost all the persons affected with granular conjunctiva who present themselves at University College Eye Infirmary, I find, on inquiry, to be from the South of Ireland. In the United States, according to the editor of the last American edition of this work, granular conjunctiva is very prevalent among the immigrant population.

Treatment.—In the treatment of granular conjunctiva, care and perseverance are required. Attention to diet and regimen, tonics, good air, and protection from changes of weather, are important general points of treatment. The local treatment should consist of scarification of the affected conjunctiva in the manner above described (p. 90) every second or third day, and immediately thereafter the application to it of some strong salve, such as the strong red precipitate or sulphur ointment of the Pharmacopœia (p. 85). When the granulations are large and prominent, and especially if pedunculated, they may be at once snipped off with curved scissors. After the operation, the salve is to be applied as after the scarification merely.

In the treatment of granular conjunctiva, bluestone, as above observed (p. 87), has been sadly misused. Though by it and other caustics the granulations may have been destroyed, the conjunctiva has been too often destroyed at the same time. The inflammation, the cure of which ought to be the great object aimed at, has been in general only rendered more hopelessly incurable. As to the powdered acetate of lead, I cannot speak of it from much experience. See above, p. 86.

2nd.—*Vascular cornea and pannus.*

Vascularity, and more or less opacity and thickening of the conjunctival layer of the cornea are not of unfrequent occurrence in chronic conjunctivitis. In a slight degree it is named *vascular cornea;* but when the vascularity and thickening of the conjunctiva corneæ are so great that the cornea wholly or in part appears as if covered with a bit of red cloth, the state is named *pannus.* (Plate II., fig. 1.)

Vascular cornea or pannus is, as has been just stated (p. 259), often kept up and aggravated by granular conjunctiva. The continued irritation from inverted eyelashes is also a very common cause of this morbid condition of cornea.

Treatment.—The source of irritation being removed, the vascularity of the cornea sometimes subsides of itself, or with the assistance of local applications, such as the strong red precipitate ointment (p. 85). Often, however, it persists, in spite of treatment, or, having been removed, readily returns.

A peculiar plan of treating the granular conjunctiva and pannus left by Egyptian ophthalmia, suggested about fifty-four years ago by Dr. Henry Walker,[*] and which, in many cases, has succeeded in the hands of others, is to excite in the eye a new attack of purulent ophthalmia by means of inoculation (p. 168, *note*).

This would seem a hit or miss proceeding, even if we could always calculate on the cornea becoming clear, and the granular condition of the eyelids being cured, in the cases in which we might succeed in saving the eye from total destruction. The induced attack of purulent ophthalmia, however, is stated to run a less violent and destructive course than an original attack.

The matter (that from the eyes of an infant labouring under ophthalmia neonatorum will do, and is the most generally attainable for the purpose) is to be taken up with a camel's hair pencil and freely applied to the conjunctiva of the eye affected with granular conjunctiva and pannus; whereupon, the desired inflammation supervenes in the course of from six to ninety hours.

3rd.—*Cuticular conjunctiva.*[†]

In this disease, the conjunctiva is so changed in structure as to present more of the characters of skin than mucous membrane; its epithelium, the epithelium of the cornea included, being thickened, dry, and semi-opaque, like epidermis. Its surface is no longer duly lubricated with its natural mucous secretion, and in one case—that of a chimney-sweeper—I found it refuse being moistened with the tears, as if it had been greasy. Along with this change in structure, there is general contraction of the whole conjunctiva, even to obliteration of the palpebral sinuses (p. 109).

Subjective symptoms.—The vision is impaired in proportion to the dimness of the epithelium of the cornea, the eye feels dry, the surface of the conjunctiva is but little sensible, and the movements of the eyeball and eyelids are restricted.

Causes.—Cuticular conjunctiva is commonly the result of some external ophthalmia, such as catarrhal, scrofulous, scrofulo-catarrhal, or the like, which by neglect or mistreatment has been allowed to fall into a chronic state, and which chronic state has been long kept up by exposure to dust and acrid vapours, by the inappropriate use of irritating applications, such as the nitrate of silver drops, or by the irritation of inverted eyelashes. The disease may also arise in consequence of the chronic conjunctivitis kept up by the exposure of the conjunctiva in ectropium.

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[*] Edin. Med. and Surg. Journal. 1811.

[†] Conjunctival xeroma or xerophthalmia.

The dryness of the eye in this disease, and even the disease itself, have been supposed to be immediately owing to obliteration of the lacrymal ducts; but though there may sometimes be suspension of the lacrymal discharge, this is not always so, for in some cases the patients have been found to shed tears. In the case above referred to, for example, the tears flowed copiously on some inverted eyelashes being plucked out. It is not, however, the tears which constitute the ordinary means of moistening the eye, but the conjunctival secretion. The suppression of this, therefore, is the cause of the dryness, and the cause of the suppression is the alteration in structure of the conjunctiva above described. See *lacrymal xeroma*, under the head of diseases of the lacrymal organs.

Prognosis and treatment.—Cuticular conjunctiva having been found incapable of radical cure, the treatment can only be palliative; and this must consist in occasionally bathing the eye with tepid water. When the surface of the conjunctiva repels the moisture, as if greasy, aqua potassæ may be added to the water in the proportion of three or four drops to two ounces.

M. Coursserant has observed marked benefit to arise from keeping the eyelids for a long time closed and bound up.*

4th.—*Onyx and abscess of the cornea.*

The nature of onyx and abscess of the cornea has been above described (p. 114 *et seq.*), and their occurrence in various ophthalmiæ referred to when considering the latter. All that requires to be said here on the subject is, that in the treatment no direct interference with the onyx or abscess is in general admissible. The only indication is to subdue the inflammation which has given rise to it as quickly as possible, and then nature will do what can be done for its removal.

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* French translation of this work, p. 280.

5th.—*Ulcers of the cornea.*

Ulceration of the cornea has been above described (p. 116, *et seq.*), and its occurrence and characters in the various ophthalmiæ considered. It may be here further remarked that destructive ulceration of the cornea, without much or any appearance of inflammation of the eye, is sometimes observed in cases of great exhaustion of the system from whatever cause (as after typhus), and also in cases of disease of the fifth pair.

The *Treatment* of ulcers of the cornea comes under the head of that of the ophthalmia which has given rise to them; but such details as the following may be mentioned here:—1. As chronic superficial spreading ulceration of the cornea is frequently accompanied by a granular state of the palpebral conjunctiva, this source of irritation requires to be particularly looked to. 2. When a deep ulcer is threatening to penetrate the cornea, evacuation of the aqueous humour often proves of great service by taking off the strain from the ulcerated part; and the inflammatory action usually receiving thereby a check, the conditions are rendered favourable for the operation of remedies and the establishment of granulation. 3. When an ulcer of the cornea near the centre threatens to penetrate, it is advisable to keep the pupil under the influence of belladonna, in order that, should perforation and consequent escape of the aqueous humour take place, prolapse of the iris may not follow.

Sometimes the whole surface of an ulcer of the cornea is found covered with a matter resembling (to use the comparison of Mr. Wardrop) wet chalk. This appearance is attributed by Dr. Jacob to a precipitate from the acetate of lead solution so frequently employed as an eye-water. Beer had frequently remarked that the use of lead lotions rendered the cornea opaque. Any part of the conjunctiva, whether abraded or not,* may be the seat of the deposit, but attention is most usually drawn to it when on the cornea. The white deposit is apt to become fixed in the cicatrice, which is then dense and indelible. Dr. Jacob* says that the opacity appears to be produced at once by a single application. He has seen it the day after a drop of solution of acetate of lead had been put into the eye by mistake. A white deposit does not take place in all cases in which the acetate is used; but Dr. Jacob says that he does not think he can state positively the precise condition of the ulcer which causes it.

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* This is well seen when the powdered acetate of lead has been applied in granular conjunctiva, see p. 86.

Dr. Mackenzie recommends a cautious attempt to be made to remove, with a small silver spatula, the white deposit from the surface of the ulcer; and he tells us that in one case he succeeded in separating a scale of lead which had been deposited on the cornea. In general, however, it is safer not to interfere in this manner. I have seen the scale become detached spontaneously, as the ulcer healed.

The late Mr. Tyrrell† described a particular disease of the cornea under the name of "Inflammation of the Cornea with deposition of earthy matter," which he considered to be the same as the alleged accidental deposition on ulcers of the cornea, from lead lotions, above described.

6th.—*Opacities, and specks of the cornea.*

Opacity of the cornea is a frequent consequence of inflammation, and is owing either to interstitial deposition, or to the cicatrization of an ulcer. The opacity occurs in various degrees of density, extent, and permanency, from a mere speck, which tends ultimately to disappear, to a dense and indelible opacity, involving, perhaps, the whole centre of the cornea, and concealing the pupil.

Opacity from interstitial deposition—Nebula—Albugo.—The speck called *nebula* is semi-transparent, and so shaded off at its circumference, that it presents no precise limits. An *albugo* is also shaded off at its circumference, but its centre is densely opaque, and slightly elevated; both of which characters are owing to the larger quantity of exuded lymph than in the simple nebula. A nebula is usually the result of diffused, but slight, exudation; albugo, again, is the result of circumscribed, but more copious exudation, which has not been matured into a phlyctenula or pustule.

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* Dublin Hospital Reports, vol. v. p. 370.

† Practical Work on the Diseases of the Eye, 1840.

Sometimes one or more vessels are seen running into an albugo, and very generally there may be observed, both in cases of albugo and of opaque cicatrice, nebulous streaks extending towards them from the circumference of the cornea, indicating where vessels had run.

Treatment of opacity from interstitial deposition.—In proportion as the inflammation subsides, the opacity diminishes; therefore no special remedy is required for the opacity in the first place, and in the second, it is proper to wait and see what the natural absorbent powers of the part can effect, which, especially in young persons, is often a great deal. If the opacity continues, and if it is so situated as to disturb vision, then we may try what local applications, counter-irritation, and especially tonics and change of air will do. The local applications which have been found most useful, are the drops of the bichloride of mercury with vinum opii (p. 83), the red precipitate salve (p. 85), or the dusting in of calomel.

Opacity from a cicatrice—Leucoma.—According as the ulcer of the cornea has involved merely the conjunctival layer, or both this and the proper substance, so is the cicatrice semi-transparent or perfectly white. The circumference of an opacity from a cicatrice, is usually more defined than that of opacity from simple deposition.

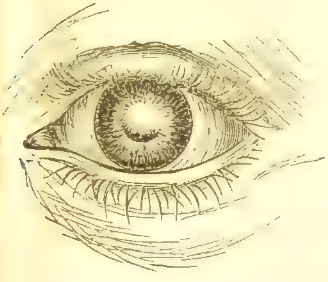

FIG. 40.

Central opacity of the cornea concealing the pupil.

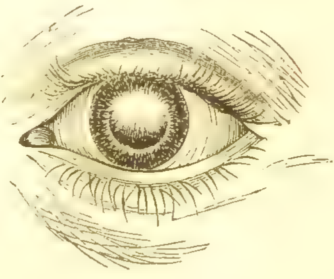

FIG. 41.

The same eye with the pupil dilated by belladonna.

Though after the healing of some ulcers of the cornea, no opacity takes place, still, when the cicatrice of an ulcer is opaque, it is indelibly so, unless the ulcer has been a mere abrasion of the conjunctiva corneæ. Though the opacity of the actual cicatrice is permanent, much of the circumferential opacity depends, like nebula and albugo, on interstitial deposition of lymph, and tends, like them, to clear away.

When an indelible opacity lies over the pupil, dilatation of this, kept up by the habitual use of a solution of extract of belladonna or of the sulphate of atropia (p. 83) dropped into the eye is a very valuable resource. Figures 40 and 41. See preceding page.

In cases in which the opacity occupies too much of the centre of the cornea for the dilatation of the pupil to be of any use, recourse must be had to the operation of cutting out a piece of the iris opposite, the clear part of the cornea (*artificial pupil by iridectomy or lateral excision*). See p. 151, and also the article on "artificial pupil," *infra*.

Dimness of the inner surface of the cornea.—The membrane of Descemet, when inflamed, is the seat of more or less milky suffusion, interspersed with numerous small opaque dots of an altogether peculiar appearance. When the membrane of Descemet, Dr. Jacob informs us, has been touched by the point of the needle in breaking up a cataract, an opacity is produced, closely resembling capsular cataract. I once observed a uniform but very slight suffusion of the membrane of Descemet produced in a woman, from whose eye I extracted a lenticular cataract, in consequence of her having, after the upper section of the cornea, suddenly turned up the eye, in which movement the flap, being caught by the upper eyelid, was folded down, and the membrane of Descemet consequently grazed by the edge of the lid. Notwithstanding this, recovery without any other untoward circumstance than the slight dimness above mentioned, rapidly took place.

7th.—*Hernia of the cornea* (*keratocele*).

For the description of hernia of the cornea, see pp. 117, 118, from which the annexed diagrams are reproduced.

Though in a case of hernia of the cornea properly so called, such as is represented in Figure $\frac{29}{43}$, the prominence may remain permanent, it sometimes happens that in the course of healing of the ulcer, it flattens down to a level with the rest of the cornea.

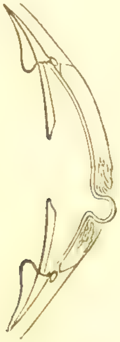

Fig. $\frac{27}{42}$.

Prolapse of the membrane of Descemet.

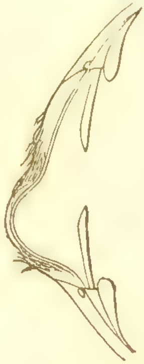

Fig. $\frac{29}{43}$.

Hernia of the cornea properly so called.

8th.—*Prolapsus iridis.*

This has been above described, under the head of "Effects of penetration of the cornea" (p. 119).

The treatment of prolapsus iridis from penetrating wound of the cornea is considered under the head of *wounds of the cornea.*

When, in consequence of penetrating ulcer of the cornea, prolapse of the iris has taken place, there should in general be no direct interference with the prolapsed iris. The attention ought rather to be continued to the removal of the inflammation, of which the prolapse of the iris is the remote consequence, in order to promote the result above described (p. 120). If the prolapsus iridis be of a size, however, likely to lead to partial staphyloma, a snip may be made in it with a pair of fine scissors, in order to allow the aqueous

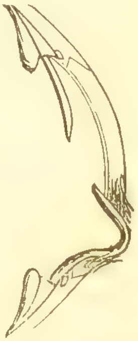

Fig. $\frac{28}{44}$.

Prolapsus iridis.

humour to drain away, and thus keep it collapsed while the cicatrice is being formed over it.

9th.—*Staphyloma of the cornea and iris.*

An unnatural prominence with opacity of a part or of the whole of the cornea of a grayish-white, or mother-of-pearl appearance:—Such is the definition which a first view would suggest of *partial* or *total spherical staphyloma* of the cornea and iris; that it is not quite accurate, however, will be shown when the nature of the morbid change comes under consideration.

Partial staphyloma.

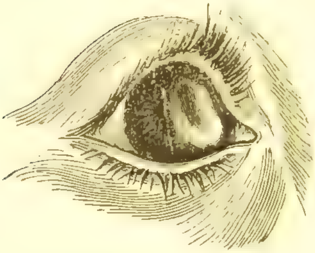

Fig. 45.

Objective characters.—Partial staphyloma most usually involves the lower or lateral part of the cornea, and may vary in extent from a quarter to a full half of the area of that membrane. On close examination, the iris is seen drawn towards, and joined to the inner surface of the opaque projection. The anterior chamber is in consequence much contracted. According to the situation and extent of the staphyloma, so is the integrity of the pupil more or less interfered with; and that either by direct incorporation of the pupillary margin of the iris, or by opacity extending to the part of the cornea over the pupil.

Subjective symptoms.—Vision is impaired in proportion to the degree in which the pupil is involved in the manner just stated. Besides this, the prominence being on the one hand exposed to the desiccant and irritating action of the air, &c., and on the other, acting as a foreign body, frequent nictitation is excited, which frets both the staphyloma and eyelids;—whence the weak state of the eye and frequent attacks of inflammation.

Total spherical staphyloma.

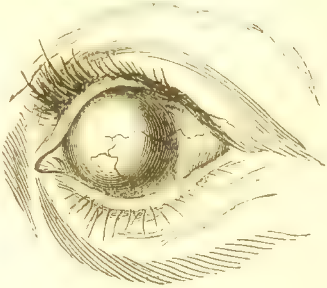

FIG. 46.

Objective characters.—In this case, the opaque structure, which represents the cornea, forms a prominence so large as to stretch and press out the eyelids, or even to project considerably from between them.

Subjective symptoms.—Vision is wholly lost; but a perception of light and shade, &c., remains.

Course.—The staphyloma may remain stationary, but sometimes it goes on increasing in size till it bursts. This is attended with very severe symptoms, such as distension in the eye, and circumorbital pain, preventing sleep, and exhausting the patient. On the bursting of the eye, these symptoms immediately subside, and if, together with the aqueous humour, the lens and part of the vitreous humour have escaped, the eye does not again become distended, but contracts into a stump, marked with depressions at the places corresponding to the insertion of the straight muscles. If all the vitreous humour has escaped, the membranes shrink back in the orbit, and form a small shapeless mass at its bottom. If the aqueous humour only escapes, the staphyloma sinks for a day or two, but soon returns to its former state, when by the closure of the laceration, the aqueous humour is allowed to re-accumulate.

Pathology.—In consequence of inflammation, the structure of the cornea is changed, the iris adheres to it surface to surface, and the two together are distended into an opaque prominence, of more or less considerable size. Such, in a few words, was the commonly received opinion regarding the formation of staphyloma of the cornea and iris up to 1838, when I enunciated a different view of the matter.*

If in scrofulous, catarrhal, or catarrho-rheumatic ophthalmia, there be a penetrating ulcer of the cornea, the aqueous humour, as has been already mentioned, escapes, the iris falls forward into contact with the cornea, and a small part of it is perhaps prolapsed through the ulcerated opening. The progress of the ulceration being stopped by the subsidence of the inflammation, the prolapsed portion of the iris, and the ulcerated part of the cornea are involved in one cicatrice. The opening in the cornea being thus closed, the aqueous humour again collects, and the anterior chamber is restored; though somewhat diminished, in consequence of the partial adhesion between the iris and cornea (*synechia anterior*). There is no prominent distension on the front of the eye in this case, because, as the inflammation subsides, the small protruded portion of iris shrinks and flattens; but if the destruction of the cornea has gone on farther, either by extension of ulceration from a continuance of the inflammation, or by the giving way of an abscess of the cornea, and considerably more of the iris has protruded, the prolapsed portion of the iris does not shrink when the inflammation begins to abate, as in the former case, but remains, and forms a projection at the part of the cornea implicated, which is generally the lower or lateral. This projection is at first merely a bag of the iris distended by the aqueous humour, and is called *staphyloma iridis;* but, by-and-by, its exposed surface becomes covered by an opaque firm tissue,

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* Medical Gazette, February, 1838.

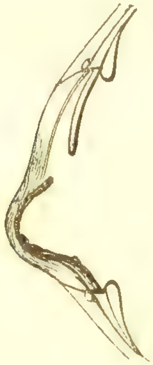

Fig. 47.

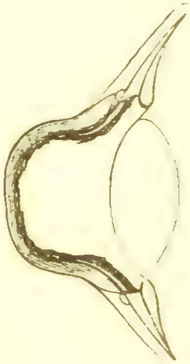

Fig. 48.

of the nature of the *tissue of cicatrice*, and this tissue is incorporated at the base of the tumour with the sound cornea. The projection, the mode of origin of which I have just described, is a *partial staphyloma* (Fig. 47); it is not a distension of the cornea itself, but a protruded portion of the iris covered by a *new tissue*, intended to supply the loss of substance which the cornea has sustained. The mode of origin of a *total staphyloma* (Fig. 48), is essentially the same, but differs only in degree. The whole or greater part of the cornea being destroyed, as occurs in gonorrhœal, purulent, and very often in variolous ophthalmia, as also in that of new-born infants, the iris falls forward, and its exposed surface gradually gets covered with an opaque cicatrice-like tissue or *pseudo-cornea*, of greater or less thickness; whilst a layer of lymph, as I have found, may be deposited on its posterior surface. The pupil becoming closed in the course of this process, the aqueous humour is allowed to re-accumulate in the posterior chamber, and by its pressure, the iris, with its pseudo-corneal investment, is distended in the form of a tumour on the front of the eye, and a total staphyloma is the result. Sometimes the central part only of the cornea is destroyed, a ring of the circumference still remaining; the staphylomatous projection has then the form of a small globe stuck on the front of a larger; or, if the cornea at its junction with the pseudo-cornea has yielded to the pressure of the aqueous humour, and especially if disease has extended to the ciliary body, the whole front of the eye is prominent like a blunt cone.—(*Conical staphyloma.*)

Sometimes when the destruction of the cornea is of small extent, the cicatricial tissue which is developed over the prolapsed iris, may, though at first prominent, subsequently become flattened from contraction. By-and-by, however, in consequence of a new attack of inflammation, perhaps, aqueous humour is poured out in increased quantity into the posterior chamber (now cut off from all communication with the collapsed anterior chamber, in consequence of the closure of the pupil), and the cicatrice, unable to withstand the pressure from behind, is proruded into a staphylomatous projection.

The pseudo-cornea, both in partial and in spherical staphyloma, is more or less pervaded by dark-coloured variose vessels.

A circumstance in the pathological anatomy of staphyoma worthy of being noticed is, that when the tumour ttains a large size, the iris, adherent to the pseudo-cornea, is torn from the choroid, and becomes, at the same time, atrophied and separated into shreds; so that when we examine the internal surface of such a staphyloma, after death, or after it has been removed by operation, we find the iris, which adheres to the pseudo-cornea, broken and reticulated; whereas the internal surface of a staphyloma, which has not reached a great size, exhibits the iris still entire.*

That the cornea and iris do not unite surface to surface, to form a staphyloma, may be inferred from what has been said above; but the following considerations, above merely glanced at (pp. 122, 135), show that such a union is not prone to take place under any circumstances:—

1. On examining a staphyloma, along with which the circumferential part of the true cornea, which still existed, had been removed by operation, I found the corresponding part of the iris, though in close contact with the latter, not at all adherent to its inner surface on which the membrane of Descemet still existed.

2. In penetrating ulcer of the cornea, and prolapsus iridis, of course the prolapsed part of the iris adheres to the cornea at the one point. But though the two membranes have come into contact in the whole extent of their surfaces, in consequence of the escape of the aqueous humour through the opening in the cornea, made by the penetrating ulcer; and though, in consequence of the attending inflammation, the circumstances favourable for adhesion exist, still the iris does not adhere to the cornea, surface to surface, as the pleura pulmonalis does to the pleura costalis. On the contrary, as soon as the ulcerated opening in the cornea closes, so that the aqueous humour is allowed to accumulate, the iris recedes from the cornea, and the anterior chamber is re-established. The only adhesion between the iris and cornea is at the one point where the prolapsus iridis took place.

3. Again, cases of penetrating ulcer of the cornea occur, in which the aqueous humour having escaped, and the iris come into contact with the cornea, but no prolapse of the former having taken place, no adhesion at all between the two ensues, but the iris recedes from the

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* Beer's Ansicht der staphylomatösen Metamorphosen des Auges. Wien, 1805. Mackenzie's Practical Treatise, 4th edition, p. 668. London, 1854.

cornea, as soon as the opening in the latter from the ulcer closes and prevents the farther escape of aqueous humour.

4. One would suppose that if adhesion between the anterior surface of the iris and inner surface of the cornea were a thing prone to take place, that it would have been observed in those cases of inflammation of the membrane of the aqueous humour in which the operation for evacuating the latter has been performed; but I apprehend no one ever saw such a result. In the operation for the extraction of the lens in cataract, the aqueous humour having escaped, the iris comes into contact with the cornea, and continues so for a considerable period; but if there be no prolapsus iridis, adhesion never takes place. If the iris does not adhere to the cornea when these two parts come into contact, from the escape of the aqueous humour, and while in a state of inflammation, much less do they adhere, independently of the removal of that fluid.

But it may be said, it is not in consequence of such inflammations of the eye that staphyloma occurs, but that purulent, gonorrhœal, and variolous ophthalmia are the most frequent causes of staphyloma? True; but under what conditions does staphyloma occur in those diseases? Not by adhesion of the iris to the cornea, surface to surface, but only when the cornea has been more or less extensively destroyed. Now purulent, gonorrhœal, and variolous ophthalmiæ are the very diseases in which, as is well known, this takes place.

This view of the pathology of staphyloma, which I first published twenty-seven years ago, and which has been, on insufficient grounds, objected to by some, has been ably illustrated by Professor Roser, of Marburg, in an elaborate monograph.*

Diagnosis of partial staphyloma.—Conical cornea can scarcely be confounded with partial staphyloma, but a form of hernia corneæ (sometimes called *staphyloma corneæ*) resembles it in being prominent, though differing from it in not being so opaque, and in not having the iris adherent to it (p. 118, fig. 29). An albugo is opaque, but not so prominent as a partial staphyloma, and, as in the preceding instance, free of any adhesion with the iris. A eucoma is opaque, and may be combined with synechia anterior, but the adhesion of the iris is comparatively of small extent, and the prominence of staphyloma is wanting.

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* Die Lehre vom Hornhaut-Staphylom. Nach dem gegenwärigen Standpunct der Wissenschaft zusammen gefasst.

Prognosis and treatment of partial staphyloma.—If the staphyloma be small and do not implicate the pupil much, the less that is done by way of treatment the better, but irritation is to be guarded against, and any tendency to inflammation kept down by occasionally dropping in a solution of nitrate of silver or diluted vinum opii. If the pupil be much implicated, however, with a part of its edge still free, an artificial pupil by lateral excision may be advantageously performed.

Prognosis and treatment of total staphyloma.—When an inflammation of the eye has run so disastrous a course that the conditions for the formation of a total staphyloma are laid, any treatment which may be adopted can have for its object, not to save the eye as an organ of vision, but to prevent it from degenerating into a tumour, which not only causes great deformity, but is a source of considerable irritation even to the opposite eye, so much so, that the patient seeks for its removal by operation, sooner or later.

Prophylactic treatment.—According to the account of the mode of formation of total staphyloma above given, it appears that the accumulation of aqueous humour in the still-existing posterior chamber, is what causes the distension of the iris, together with the pseudo-cornea developed on its surface. If this be the case, the destruction of the source of the aqueous humour, by breaking in upon the integrity of the posterior chamber, is a means which offers itself, to prevent the development of the staphylomatous projection. The simplest plan of effecting this appearing to me to be the extraction of the lens, I put the operation in practice in the following case:—

A man, about twenty-two years old, came to me labouring under the effects of severe purulent ophthalmia of both eyes. In the right eye, the cornea being destroyed and the pupil closed, the iris protruded and was distended with aqueous humour. The left eye had also suffered very much; there was penetrating ulcer, prolapsus iridis, and consequently considerable distortion and contraction of the pupil. Both eyes were still affected with the inflammation, and it was very doubtful whether the left eye could be prevented from getting worse, especially as it was evidently kept in a state of additional irritation from the presence of the staphyloma in the right. By an incision with a Beer's cataract-knife through the protruding and distended iris, the lens was extracted. Severe reaction followed; less perhaps in consequence of the operation, than from the patient not being in a situation to take proper care of himself. The iris did not again become distended; on the contrary, the eye shrank, and irritation being thus removed, the left eye progressively recovered, as far as the organic changes it had already undergone allowed, and further than there had been reason to hope for, as sufficient vision was preserved to enable the patient to resume his employment as a porter.

In those cases in which the eye is destroyed, whether in adults or new-born infants, by purulent ophthalmia, variolous ophthalmia, &c., and in which staphyloma does not result, but the pseudo-cornea which forms remains flat and the eyeball becomes atrophic, I suspect the lens has escaped on the giving way of the cornea. In a case of traumatic hypopyon, Professor Roser relates that after the destruction of the cornea, he found the crystalline body exposed, and that on the bursting of the capsule two days after the lens escaped. No staphyloma formed, but healing took place with a flat cicatrice.

A fully formed total spherical staphyloma is a source of great deformity: its removal, therefore, is often sought for in order that an artificial eye may be worn. But what principally demands its removal, sooner or later, is the irritation which it keeps up, and which is apt to be communicated to the opposite eye.

If, as is sometimes the case, the posterior segment of the eyeball has suffered from the inflammation which led to the formation of the staphyloma, so that there is posterior hydrophthalmia and dissolution of the vitreous humour, it is best to *excise the whole eyeball* (p. 286). But if, as is more commonly the case, the posterior segment of the eyeball is still healthy, abscission of the staphyloma is the operation to be performed (p. 284).

10th.—*Hypopyon.*[*]

This name has been given to a collection of pus or puriform matter occupying the bottom of the anterior chamber. In a small hypopyon (p. 121, fig. 32), the collection of matter necessarily takes a shape somewhat resembling that of *onyx* (p. 115, fig. 26), but the two kinds of cases are distinguishable from each other by the circumstances: that on turning the patient's head to one or other side, the matter of onyx does not change its place, whereas that of hypopyon does, unless, as is sometimes the case, it is thick and glutinous; and that on looking at the cornea in profile the deposition in onyx appears nearer the surface than that in hypopyon. Both onyx and hypopyon may, however, exist at the same time.

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[*] Oculus purulentus.

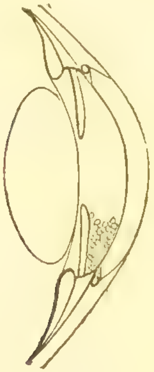

FIG. 49.

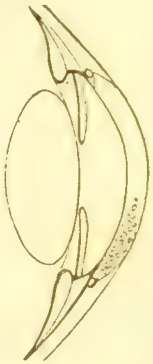

FIG. 50.

Source of the matter in hypopyon.—This is different in different cases. The matter may, as would appear from all the circumstances of the case, be poured out from the unbroken surfaces of the walls of the aqueous chambers in the same way that matter is poured out by inflamed mucous and serous membranes; or it may result from the bursting of an abscess of the iris (p. 123); or from the bursting inwards of an abscess of the cornea (p. 118). An hypopyon formed in either of the last two ways has been named false (*hypopyon spurium*), in contradistinction to hypopyon formed in the first way, and which is named true (*hypopyon verum*).

Seeing thus that the source of accumulated matter in the anterior chamber may be different, it will be at once perceived that hypopyon may be the consequence of various forms of ophthalmic inflammation, external and internal.

Treatment.—As the inflammation in which hypopyon has originated is still going on, the first indication is to subdue it as quickly as possible, and then the accumulated matter will in general soon disappear. If, however, the inflammation does not subside, and the hypopyon increases rather than diminishes, the propriety of evacuating the matter by paracentesis corneæ comes to be a question. Opinion has been divided on the point. When I perform the operation it is usually with the object simply of evacuating the aqueous humour in order to relieve pressure, and thus check the inflammation.

Should the aqueous chambers, however, be filled with matter, and should the patient be suffering great pain, we ought then to have no hesitation to make a small section of the cornea at its lower margin for the purpose of evacuating the matter.

11th.—*Prominent cornea and dropsy of the aqueous chambers.**

It has been already explained (pp. 197, 201), how an increase in the prominence and diameter of the cornea may take place in corneitis, in consequence of the softening of the texture of the cornea, on the one hand, and distension, by increased accumulation of aqueous humour, on the other. This constitutes one form of dropsy of the aqueous chambers—the form which belongs to this section.

Diagnosis.—The prominent cornea in dropsy of the aqueous chambers is distinguished from conical cornea by its spheroidal curve. See *Conical cornea.*

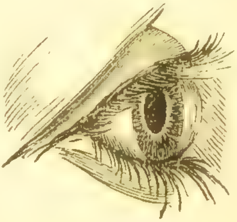

Fig. 51.

Prognosis and treatment.—In consequence of the diminished elasticity and resistance of the cornea, it cannot regain its normal degree of prominence, and thus limit the increased exudation of aqueous humour. All that can be done, therefore, in the way of treatment, is to endeavour to subdue what inflammation may still exist by the remedies adapted to the particular case, and to improve the general health by change of air, tonics, &c. Concave glasses help the sight.

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* Hydrophthalmia anterior.

In certain cases of posterior internal ophthalmia with atrophy of the vitreous humour, and dropsy of the aqueous chamber, I have found the iris much inclined backwards, without any undue prominence of the cornea. On evacuating the aqueous humour by paracentesis corneæ, the iris has resumed and retained its natural position. The sight has been somewhat, though not materially, improved.

12th.—*Synechia.*

Synechia is a morbid adhesion of the iris to the cornea or to the anterior wall of the capsule of the lens. In the former case it is named *synechia anterior*—in the latter, *synechia posterior*. According as a part or the whole of the pupillary margin of the iris is involved in the adhesion, the synechia is named *partial* or *total*. The principal points regarding the nature of synechia have been above explained (pp. 28, 120, 122, 134, 135).

Treatment.—*Synechia anterior* may be so partial, and the transparency of the cornea so unimpaired, except at the point of adhesion, that vision is not disturbed; nothing, therefore, is required to be done. If the cornea be opaque to any extent opposite the somewhat contracted and distorted pupil, dilatation of the latter by means of the habitual use of belladonna or atropia, will, in many cases, be found of the same service as in simple central opacity of the cornea, as above mentioned (p. 265). When, from the smallness of the pupil, and extent of the opacity of the cornea, however, belladonna does not yield this service, or when the synechia is total, the only prospect of restoring vision is by an operation for artificial pupil. See *Artificial pupil.*

As the iritis in which *synechia posterior* has had its origin subsides, we see, under the use of belladonna, one band of adhesion after another give way, and the pupil become free, but very often, on close examination, small grayish or brownish specks are seen on the capsule of the lens, indicating the points where the adhesion of the iris to it had been. Vision, however, may not be much disturbed by these specks, even when some of the adhesions remain. But when the adhesion of the pupillary margin is extensive, there is also more or less contraction of the pupil, and extensive deposition of lymph on the capsule of the lens, the consequence of which is, that vision is impaired to a greater or less degree, even if the same inflammation which has given rise to the synechia has not also led to some opacity of the lens as well as involved and injured the retina. This state of matters may be sometimes palliated by the habitual use of belladonna. And in course of time it may happen that detachment of some portion of the adhesion takes place, and greater dilatation of the pupil allowed, with corresponding improvement in vision. Such an event may often be advantageously anticipated by the performance of iridectomy, or the lateral excision of a bit of the iris.

Mr. Streatfeild published a case in the Ophthalmic Hospital Reports for 1857, in which he detached the adhesion of posterior synechia by operation, and thus reinstated the pupil. Since then he has enlarged on the subject of this operation, which he designates "*Corelysis.*"*

13th.—*Closure of the pupil.*†

Closure of the pupil is generally the consequence of iritis (p. 122), but it may also result from prolapse of the iris, in consequence, for example, of central penetrating ulcer of the cornea. In the former case, closure of the pupil is complicated with total synechia posterior; in the latter, with total synechia anterior.

Treatment.—See *Artificial pupil.*

14th.—*Iridauxesis or hypertrophy of the iris.*‡

This morbid state is usually a consequence of chronic parenchymatous iritis in a person of scrofulous habit; but in addition to the iritis, there has also been inflammation of the posterior tunics, as manifested by attenuation of the sclerotica, varicosity of the vessels of the white of the eye, and hardness of the eyeball.

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* Ophthalmic Hospital Reports, Vol. II., p. 309.

† Atresia iridis—Synizesis.

‡ Staphyloma iridis—Staphyloma uveæ—Iridoncosis—Lymphoncus iridis—Exudation of lymph into the tissue of the iris.

Hence vision is very greatly impaired, if not wholly extinguished, even although the pupil may not be much obstructed.

The pupillary margin of the iris is generally retracted and adherent to the capsule of the lens all round (*total synechia posterior*), the body of the iris which is bolstered forwards, presents black elevated spots on its surface, looking as if it were perforated here and there, or as if its proper substance were gone, and the uvea appeared or even protruded through. The proper substance of the iris which remains evident is changed in colour, and has a remarkable fibrous appearance. Fig. 52.

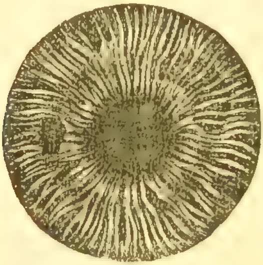

FIG. 52. From Klemmer.

From the observations of Dr. Klemmer and others, this change would appear to consist in a thickening of the iris from exudation of lymph into its substance. In this lymph new vessels are developed, and deposition of pigment subsequently takes place producing the dark spots.

The operation of iridectomy has been sometimes had recourse to in such cases, but without any good result, in consequence of the morbid condition of the posterior segment of the eyeball, as well as the degenerated state of the iris itself.

15th.—*Sclerotico-choroid staphyloma.*

Sclerotic staphyloma consists, as above stated (pp. 110, 111, 237), in an attenuation and bulging out of some part of the sclerotica, in consequence of softening of its texture from inflammation and increasing intra-ocular distension by accumulated fluid arising from the same cause.

The staphylomatous bulging is of a bluish-black tint, owing partly to the deposition of pigment in the substance of the attenuated sclerotica, and partly to the dark pigment of the atrophied choroid on its interior shining through.

The fluid within the staphylomatous bulging has its seat either between the united sclerotic and choroid on the one hand, and the retina on the other (*subretinal* *dropsy*), or within the retina in the seat of the vitreous humour (*dropsy of the vitreous humour*).

Staphyloma of this sort may involve any part of the sclerotica,—the posterior or lateral or anterior.

When it is the posterior part of the eyeball which is the seat of the staphyloma, it may be recognised by help of the ophthalmoscope (pp. 60, 300). When it is the anterior part, it is, of course, directly seen.

When sclerotic staphyloma affects the anterior part of the eye, the bluish-black prominence or prominences, of a greater or less size, are generally adjacent to one or other side of the cornea, in the region of the ciliary body —more commonly the upper and temporal side—or even all round. The white of the eye is at the same time pervaded by varicose vessels. (Plate IV., figure 2.)

The same inflammation (viz., posterior internal ophthalmia, in which the sclerotica and choroid are especially affected,) which has given origin to sclerotic staphyloma, has usually at the same time occasioned other morbid changes in the eye.

In the sclerotic staphyloma under notice, vision is generally nearly or altogether extinct.

By increasing accumulation of fluid, the staphylomatous projections may go on to increase in size so that the eyeball comes to protrude from between the eyelids, and there is at the same time great pain from distension. At last the eye may burst and evacuation of the fluid take place, in which case it may either remain shrunk, or the opening closing, it may become again distended. On the bursting of the eye, copious—even dangerous—hæmorrhage may take place.

Treatment.—The restoration of vision is out of the question. Treatment of the staphyloma, therefore, is only called for to relieve the pain arising from distension of the eyeball by the accumulation of fluid, and to reduce the size of the prominence if very great.

Evacuation of the fluid by puncture relieves the distension of the eyeball, and produces collapse of the staphylomatous projection for the time. The fluid, however, by-and-by, re-accumulates; but, by repeating the evacuation over and over again, re-accumulation may at last cease to take place, and the eyeball will shrink to a small size. In regard to evacuation of the fluid as a means of relieving the pain from distension, it is to be observed, that immediately on evacuation, there may be great exacerbation of the pain, but this gradually subsides, and at last more or less perfect relief is obtained.

When the whole front of the eyeball is involved in the staphylomatous degeneration, and no progress in its diminution has been made by repeated puncture, abscission of it, as in common staphyloma, is sometimes had recourse to, in the hope that the eyeball will shrink to a stump, fit for supporting an artificial eye.

If, however, the vitreous humour be, as it often is in such cases, softened, it will be lost, and no good stump obtained. In consequence, moreover, of the morbid state of the eye, troublesome, if not sometimes dangerous, hæmorrhage is liable to occur. For these reasons, the best plan is to excise the whole eyeball at once from the ocular capsule. After this, as will be seen below, an artificial eye may still be worn.

16th.—*Synchysis.**

This name is given to a morbid state of the vitreous body, consisting in atrophy or solution of the hyaloid, in consequence of which the vitreous body is reduced from its natural gelatiniform to a diffluent state. This we are made acquainted with by dissection; but what are the symptoms of synchysis during life? As the quantity of vitreous fluid may be increased or diminished, there may be hardness or softness of the eyeball; often, however, there is no marked change in the natural consistence. Sometimes there is a tremulousness of the iris, sometimes none.

Synchysis, though often a consequence of internal inflammation, and an accompaniment of impaired sensibility of the retina, is a change to which, with the advance of life, the vitreous body appears to have a tendency in the same manner that the lens has to opacity. The cataract of old people is, indeed, often combined with some degree of synchysis, and this is the cause of the principal danger attending the operation of extraction, viz., escape of the dissolved vitreous humour. See below.

The sparkling appearance produced by the presence of cholesterine crystals in the dissolved vitreous humour to which the name of *synchysis scintillans* has been given, is above noticed (p. 35).

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* Dissolution of the vitreous body.

17th.—*Atrophy of the eyeball.**

Atrophy of the eyeball is the result of chronic inflammation, which has fixed itself primarily or secondarily in the internal structures of the eyeball, especially the posterior.

Scrofulous, purulent, syphilitic, arthritic, traumatic, and sympathetic ophthalmiæ, are the inflammations which, implicating all the internal structures of the eyeball, and, becoming chronic, are most apt to leave the eyeball atrophic.

Morbid enlargement of the eyeball may precede atrophy.

Atrophy of the eyeball presents itself in various degrees, from that in which it has lost merely its natural plumpness and feels soft to the touch (p. 14), to that in which it has become so flaccid and shrunk, that it is indented at the places corresponding to the recti muscles, the cornea small though still clear, its prominence gone, and the eyelids fallen in.

The softness and diminution in size of the eyeball as a whole is owing in a great measure to a reduction in the mass of the vitreous body; but besides this, there are disease and wasting of other structures, and especially a more or less morbid condition of the retina. With the morbid condition of the retina, indeed, it is probable that the change in the state of the vitreous body is more particularly connected. The alterations in the other structures of the eye it is not necessary here to notice in detail, much less the changes in structure, which dissection discloses, in eyes which have been long atrophic.

In atrophy of the eye, the prognosis, as regards vision, is altogether unfavourable. Even at an early stage, and though the pupil is free, and the lens still transparent, vision is very much and irretrievably deteriorated; in a more advanced stage, it is reduced to a mere perception of light and shade, or even wholly lost.

The eyeball may, in the course of internal inflammation, become somewhat soft, and yet recover its natural consistence. This, according to Dr. A. Anderson, sometimes happened in cases of the postfebrile ophthalmitis above described (p. 254, et seq.), after recovery from the attack, but such a degree of softness scarcely comes under the head of atrophy of the eyeball.

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* Atrophia bulbi.—Phthisis bulbi.

18th.—*Shrunk state of the eyeball from evacuation of humours.*

In consequence of extensive ulceration or sloughing of the cornea, or bursting of the eye, as in ocular phlegmon, or wound, the humours of the eyeball may be partially or wholly evacuated; the effect of this is collapse of the tunics, and after cicatrization, the reduction of the eye to a mere stump.

This state of the eyeball is to be distinguished from *atrophy.*

19th.—*Operation of abscission of the anterior segment of the eyeball.*

Total spherical staphyloma is the disease in which abscission of the anterior segment of the eyeball is most commonly performed. The other cases in which the operation is sometimes had recourse to, are those in which the eyeball has become, from disease or injury, useless as an organ of vision, and is, by the irritation and pain of which it is the seat, seriously affecting the opposite eye, but in which the posterior segment appears still sufficiently healthy to close in and form a good stump—a condition without which it is better to excise the whole eyeball.

In determining the size of the piece to be cut away in a staphyloma, we should take into consideration the circumstance whether the patient intends to wear an artificial eye or not. In the one case, a larger piece should be cut away in order to reduce the eyeball to a proper sized stump for the support of an artificial eye (p. 290); in the other case, a smaller piece, and none of the circumferential part of the real cornea, which may still exist, in order to preserve the size and natural appearance of the eyeball as far as possible.

The patient may lie on a table or be seated on a chair. When the patient is seated on a chair, he leans his head on the breast of an assistant who stands behind, and who also supports the chin with the palm of one hand, whilst with the fingers of the other he raises the upper eyelid. Supposing it to be the patient's left eye which is to be operated on, the assistant uses his right hand to support the chin, and his left hand to raise the upper lid. The surgeon himself, then, depressing the lower eyelid with one hand, proceeds in the following manner:—

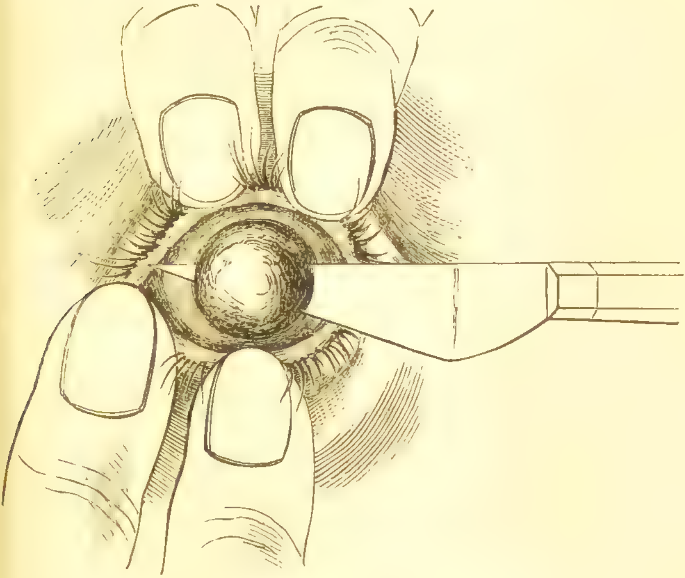

FIG. 53.

With the staphyloma-knife, which is merely a large cataract knife, its edge directed downwards, he transfixes the tumour from the temporal to the nasal side, and somewhat above its transverse diameter. Pushing the knife on, it cuts itself out, and a flap is formed, as in the operation for extracting the cataract. The flap thus made is seized with a hooked forceps, and the abscission completed with a pair of curved scissors. If the lens still exists, it is to be extracted, if it does not escape spontaneously.

After the operation, the eyelids of both eyes are to be kept closed by strips of court-plaister, and covered with a light compress and roller.

There is usually little hæmorrhage at the time, if the posterior segment of the eyeball be healthy; but it occasionally happens, especially in cases in which the posterior segment of the eyeball is in the morbid state above mentioned, that, some hours after, the eyeball becomes distended with blood, and the clots, or infiltrated vitreous body, protrude from the wound. Considerable hæmorrhage may even take place.

Under ordinary circumstances, the healing process proceeds favourably. The wound becomes covered with granulations. These are condensed into a semi-transparent membrane, which, by-and-by, becomes dense and opaque, and contracts into a cicatrice, marked with bluish or brownish streaks (p. 129). Sometimes a fungus grows from the wound, which is to be snipped off, and its root touched with lunar caustic.

To leave the wound to granulate and close in of itself, as here directed, is a better plan than the closing of the wound by suture immediately after the operation, as has been recommended.

If severe reaction follows the operation, antiphlogistics, anodynes, and warm fomentations, &c., will be required.

If, in consequence of a morbid state of the posterior segment, hæmorrhage continues, notwithstanding the employment of cold applications, it may become advisable to excise the remainder of the eyeball from the ocular capsule.

20th.—*Operation of excision of the eyeball from the ocular capsule.**

This operation, for the principle of which we are indebted to Dr. O'Ferrall, of Dublin, is referred to under the head of the various morbid states in which it is called for.

The *first step* in its performance is, to cut through the conjunctiva all round, and close to the circumference of the cornea; the *second*, to cut the tendons of the recti muscles at their insertions into the sclerotica; the *third*, to dissect all round the eyeball between it and the ocular capsule, down to the optic nerve; the *fourth*, to divide the optic nerve at its entrance into the eyeball; and the *fifth*, to complete the excision by detaching the insertions of the oblique muscles, and all adhering cellular tissue from the sclerotica.

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* Enucleation of the eyeball.

The instruments required are:—1st. A wire spring speculum (Fig. 54.) 2nd. A pair of tooth-pointed forceps. 3rd. A pair of straight, blunt-pointed, well-cutting scissors. 4th. A strabismus-hook (Fig. 55). 5th. A sharp-pointed hook. 6th. A pair of strong probe-pointed scissors, curved on the flat.

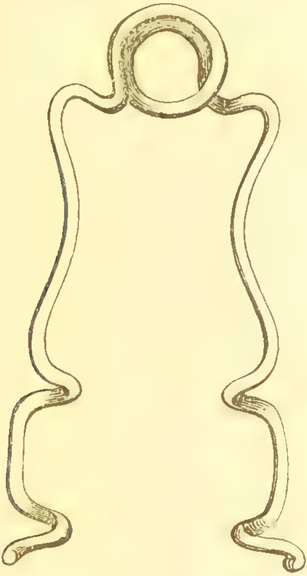

Fig. 54.

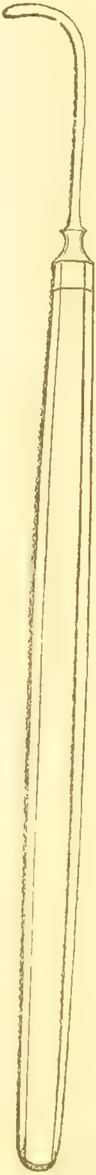

Fig. 55.

The patient should lie on his back on a table, and be brought under the influence of chloroform.

First step.—The eyelids being held apart by the wire spring speculum, the surgeon, with the toothed forceps in his left hand, seizes the conjunctiva at the margin of the cornea on the nasal side, and raises it up in a fold in a direction radiating as if from the cornea. This fold he cuts through down to the sclerotica, as close to the margin of the cornea as possible, with the straight blunt-pointed scissors held in his right hand. From this point and in this manner he proceeds, cutting the conjunctiva all round the cornea, down to the sclerotica, and detaching it therefrom, along with as much of the sub-conjunctival cellular tissue as possible. If the right eye be the subject of the operation, the division of the conjunctiva all round is most conveniently effected from the first incision at the nasal side, along the lower margin of the cornea, next round the outer and thence along the upper margin, back to the nasal side. When the left eye is the subject of the operation, it is more convenient to proceed from the first incision at the nasal side along the upper margin, next round the outer and thence along the lower margin, back to the nasal side.

Second step.—The conjunctiva having been thus cut close to the cornea all round, and retracted along with the sub-conjunctival cellular tissue, the surgeon raises up the tendon of the superior rectus with the strabismus hook, and cuts it across with the scissors close to the sclerotica. He next detaches the tendon of the internal rectus in the same way, and after that the tendon of the inferior rectus. The tendon of the external rectus may be left to be divided at the end of the operation, in the fifth step, along with the tendons of the oblique muscles.

Third step.—The speculum being removed, and the eyelids held apart by an assistant, the eyeball is now to be seized on its nasal side as far back as possible, either with the toothed forceps, or what is better, a sharp double hook, and dragged forwards and outwards, as if from the orbit. At the same time that he is doing this, the surgeon, with the bent probe-pointed scissors, cuts the cellular tissue close to the sclerotica, between the eyeball and the ocular capsule down to the optic nerve.

Fourth step.—The eyeball being still dragged forwards and outwards from the orbit, the bent probe-pointed scissors, closed, is now to be passed down on the nasal side, with its concavity close to the eyeball, until its point reaches the optic nerve. The surgeon then opens the scissors, grasps the optic nerve between its blades, and cuts it through close to the sclerotica.

Fifth step.—The optic nerve being cut, the eyeball admits of being dragged completely out of the orbit. All that now remains to be done, therefore, is to cut through the adhering cellular tissue close to the selerotica, to detach the oblique muscles at their insertions, and lastly, supposing the tendon of the external rectus to have been left uncut, to detach it also.

The object in directing the cellular tissue and tendons to be detached so close to the sclerotica is, that as much substance as possible may be preserved in the orbit for the support of an artificial eye.

The bleeding is usually not great, and soon ceases, without the application of a ligature to any artery being required.

The blood being wiped away with a sponge, the surgeon satisfies himself that the cut edges of the conjunctiva are lying in a proper position to be approximated when the space left by the removal of the eyeball has become filled up with granulations, and cicatrisation takes place.

The eyelids are then closed, and a compress and bandage applied.

The healing and cicatrisation of the wound is completed in a week or ten days, but the patient may be up and about much earlier.

A sufficiently good socket for the insertion of an artificial eye is afforded by the folds formed by the reflection of the conjunctiva from the eyelids on to the remaining contents of the orbit. The recti muscles even still exert an action on the tension of the conjunctival folds, and thus communicate some slight movements to the artificial eye. Such movements are, however, much inferior in extent and range to those presented by an artificial eye which has the support of a good stump, formed by the remains of the eyeball.

21st.—*Adaptation of an artificial eye.**

An artificial eye is a shell of enamel, representing the ront of the eyeball, the loss of which it is intended to onceal. It should be of such a shape as to admit of eing introduced behind the eyelids, and of fitting, by its ollow posterior surface, over, but without touching, or at ast, pressing on, the stump-like remains of the eye; and y its margins, into the folds formed by the reflection of e palpebral and ocular portions of the conjunctiva into ch other.

When the whole eyeball has been excised, the artificial eye, we have seen, is supported in its place only by its margins being fitted into the folds formed by the reflection of the palpebral and ocular portions of the conjunctiva into each other.

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* Prothesis ocularis.

The cases adapted for the wearing of an artificial eye are—

1st. Those cases in which the cornea is destroyed by purulent ophthalmia, whether in adults or new-born infants, by gonorrhœal ophthalmia, variolous ophthalmia, &c., and in which staphyloma has not resulted, but the cicatrice formed in the place of the cornea is flat (p. 275).

2nd. Those cases in which the eye is intentionally reduced to the state just described by the operation of abscission of the anterior segment of the eyeball (p. 284).

3rd. Those cases in which the whole eyeball has been excised (p. 286).

When the remains of the eye are of a very small size, as after the loss of much or all of the vitreous humour, as may happen from the bursting of the eye in purulent ophthalmia, or in ocular phlegmon, or during the operation for staphyloma, or when the whole eyeball has been excised, there is not so good a support for an artificial eye.

Cases of atrophy of the eyeball do not in general bear the wearing of an artificial eye so well.

Of course before the use of an artificial eye is thought of, the remains of the eye must be perfectly cicatrised, and the conjunctiva free from inflammation and morbid sensibility.

An artificial eye, besides resembling the opposite sound eye in the colour and appearance of the iris, &c., ought, if the stump be good, to move in concert with it: this it does by following the movements communicated to the conjunctival folds, into which its margins are fitted, by the movements of the stump. It ought at the same time to cause no pain or uneasiness, and to permit the eyelids to close freely and completely over it.

For the accomplishment of all this, it is advisable for the patient to apply personally to the artificial-eye maker.

Introduction of an artificial eye.—Raise the upper eyelid, and, whilst the patient looks downward, slide the artificial eye, previously dipped in tepid water, up behind it, by the end which is to correspond to the temporal angle.

Then turning this end towards the temporal angle, and letting the upper eyelid fall, depress the lower, while the patient looks upward, and make the lower edge of the artificial eye slip into the lower palpebral sinus. This being done, and the lower eyelid allowed to rise, the introduction of the artificial eye is accomplished.

Removal of an artificial eye.—The artificial eye is withdrawn by an opposite procedure, viz., by depressing the lower eyelid, and with a large pin, or a bit of wire bent like a hook, or even the thumb-nail, hooking the lower edge of the eye out from the lower palpebral sinus; whereupon the eye will glide down from behind the upper eyelid, and fall into the hand ready to receive it. In doing this himself, the patient should lean his face over a soft cushion, or the like, in order that if the eye should slip out of his fingers it may not be broken in the fall.

The artificial eye is withdrawn on going to bed. Immediately on being withdrawn, it is to be dipped into water, and wiped with a soft lawn handkerchief, in order to cleanse it from the mucus which may be adherent to it. It is then to be wrapped up in a bit of tissue paper, and put by until the morning.

Both before putting in the artificial eye, and after withdrawing it, the person should bathe his eye with water, tepid or cold.

An artificial eye after being worn for some time is liable to excite irritation of the conjunctiva, which, in consequence, becomes much congested, thickened, and on the inside of the eyelids beset with sarcomatous or polypus-like excrescences. In this case the use of the artificial eye requires to be intermitted. The excrescences should be snipped off with scissors, and the conjunctiva freely scarified. The bleeding, which is considerable, having ceased, the strong red precipitate ointment is to be applied to the surface. This may require to be repeated oftener than once, at intervals of a few days, the patient in the meantime bathing the eye twice or thrice a day with the bichloride of mercury lotion (p. 81).

The artificial eye in the course of a year or so becomes rough, from the slow corrosive action of the humours which come into contact with it, and requires to be exchanged for a new one. As it is also liable to be broken by accident, a person using an artificial eye should always have several ready by him.

CHAPTER III.

SECTION I.—PARTIAL AND GENERAL ENLARGEMENTS OF THE EYEBALL.—DROPSICAL EFFUSIONS.—EXTRAVASATIONS OF BLOOD.—HYDATIDS.

1st.—*Conical cornea.**

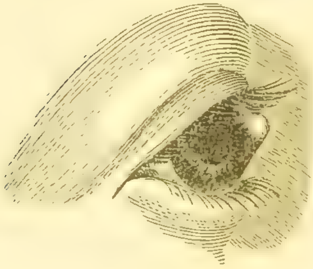

FIG. 56.

Objective characters.—Viewed in front, the eye affected with conical cornea has a peculiarly brilliant and sparkling appearance, in consequence of the mode in which it reflects the light. Viewed in profile, the conical prominence is evident, and the cornea appears dark between the apex and base of the cone. When the prominence of the cornea is very considerable, the eye cannot be kept long and steadily directed forward, but is, by the action of the eyelids, always turned either to the one angle or the other. From the irritation to which it is exposed, the apex of the cone is liable to become more or less opaque, and even ulcerated.

Subjective symptoms.—Short-sightedness first attracts attention, by-and-by vision becomes very indistinct at any distance. The patient can then recognise objects only when held close to the eye to one or other side, so that the rays of light may pass through the cornea as near its circumference as is compatible with their entrance into the pupil. In this state, half closing the eyelids or looking through the small aperture of a stenopæic apparatus (p. 70), assists vision.

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* Hyperkeratosis.—Staphyloma pellucidum —Conical hydrophthalmia.—Kerato conus.

Conical cornea is rather a rare affection. Females have been found more frequently the subjects of it than males. Though it occurs most commonly after puberty, Mr. Wardrop has met with conical cornea in a boy of eight, and Dr. Ammon once saw it congenital in three sisters. Both eyes usually become affected either at the same time or one after the other. Less commonly is the disease limited to one eye. For the most part, the cornea slowly undergoes the change to the conical form.

Morbid anatomy.—Opinion has been divided on this point; some asserting that the centre of the cornea is thickened, others maintaining the contrary to be the fact. The late Dr. Jaeger, of Erlangen, examined the eyes of a person affected with conical cornea, who died of phthisis. The middle of the cornea forming the apex of the cone was in the right eye one-third, and in the left eye one-half thinner than natural. In both eyes the circumferential portion of the cornea was thickened. Mr. Middlemore* has also had an opportunity of examining, after death, the state of the cornea in a person affected with the disease in an extreme degree. He found the circumference of the cornea of the ordinary and natural thickness, but its apex much thinner than usual. The same has been since observed by others.

The *causes* of conical transformation of the cornea are unknown. It is not necessarily connected with preceding inflammation, though in some cases this has been observed. In the cases which have come under my notice, the patients have been of a scrofulous constitution with coarse dark skin, and sometimes labouring under a derangement of the urinary secretion.

Diagnosis.—The morbid affections of the cornea, which might be confounded with conical cornea, are:—

1st. The prominent cornea, occurring as a consequence of corneitis (p. 277, et seq.).

2nd. Hernia of the cornea (p. 266).

3rd. Partial staphyloma of the cornea and iris (p. 268).

The characteristics of these, and their differences from conical cornea, are pointed out in the proper place; here it is necessary only to remark that, as in the early stage, the vivid reflexion of the light is not very striking, the nature of the case may be altogether overlooked, if the practitioner does not take care to examine the eye from the side.

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* Treatise, vol. i. p. 533.

Reference has been above (p. 61) made to certain appearances indicative of the existence of conical cornea, observable in the course of an ophthalmoscopical examination, supposing the nature of the case not to have been noticed in the ordinary way. It is here further to be remarked that, under the ophthalmoscope, the summit of the cone stands out dark on the illuminated red fundus.

In respect to its subjective symptoms alone, viz., the increasing short-sightedness, and at last indistinctness of vision at any distance, a case of conical cornea might be confounded with amblyopia, or incipient cataract.

In illustration of the characters of conical cornea, the following two cases are given:—

A young man, æt. 21.—The cornea of the left eye is conical in an extreme degree—running almost into a point at the middle. Here it is slightly opaque, with streaks radiating towards the circumference. The cornea of the right eye much less affected. The sight of the left eye is so imperfect that the patient cannot make out pretty large type, except with great difficulty, and only when he holds the book in the closest proximity to the eye. Concave glasses do not help the sight. The sight of the right eye as yet admits of being somewhat improved by a concave glass.

The skin dark, with the sebaceous follicles of the face considerably developed. The urinary secretion deranged.

A young woman, œt. 21.—Skin dark and coarse. Three years ago, or more, she discovered the sight of the left eye to be dim. Since then the dimness has gone on to increase. Lately, the vision of the right eye has become dim; she requires to hold the book as near the left eye as two inches to be enabled to read it. With the right eye can still read distinctly at the distance of six or eight inches. On examination, the cornea of the left eye is seen to be conical. Reflexion of the light by the cornea is very striking. A little below the middle of the same cornea there are two very minute spots of opacity. The cornea of the right eye is slightly prominent, and reflects the light like the left cornea, but in a less degree. She has such a feeling of uneasiness of the eyes, that it prompts her to close them in order to obtain relief. Sometimes she has a shooting pain in the temple, sometimes a throbbing in the eyeball. Some months ago used to see sparks of fire before the eyes; this, although not quite gone, is much diminished.

The *prognosis* of conical cornea is unfavourable. Sometimes the disease, after a slight degree of development, has its further progress arrested. In general, however, the sight goes on to become more and more confused and indistinct.

Treatment—In entering upon this part of the subject, it is well to premise, that restoration of the cornea to its natural form is not to be calculated on. The only indications, therefore, are to arrest the deforming process if possible, and to provide some kind of glass calculated to compensate the malformation of the cornea; or to try by an operation to rectify somewhat the disordered optical condition of the eye.

As a means of arresting the deforming process, counter-irritation, astringents locally, and tonics, or iodine internally, have had some equivocal testimony in their favour. So, likewise, repeated evacuation of the aqueous humour, and pressure over the closed eyelids.

As to glasses, deep concaves afford assistance to vision in the slighter degrees of the complaint, but are useless in the more developed degrees.

In a woman about seventy years of age, affected at the same time with conical cornea and cataracts, Sir William Adams successfully removed the latter, and found that the patient could afterwards see much more distinctly without convex glasses, than is usual for those who have undergone the operation for cataract. Encouraged by this, he removed the transparent crystalline lens, by the operation of division, from one of the eyes of a young woman affected with conical cornea in both. The ultimate result, he says, was beneficial. Others, however, assert, that the operation does no good, which theoretically was to have been expected, as a concave glass was likely to afford all the assistance which removal of the lens could by possibility do.

Dilatation of the pupil by belladonna has been said to assist vision. This it may do by allowing the rays to enter the eye through the less deformed circumference of the cornea. In the second of the above cases, however, the sight became dimmer after the use of belladonna. Dilatation of the pupil, aided by stenopaeic spectacles (p. 70), is more effectual. Mr. Middlemore first proposed to apply Adams' operation of dislocating the pupil to cases of conical cornea, in order to bring the pupil from behind the apex of the cone to opposite a less deformed circumferential part of the cornea; and Mr. Tyrrell* informs us that he has put it in practice seven or eight times, and in each case with benefit, which in two especially was very considerable. The operation consisted simply in making a puncture, with an iris knife or the point of a cataract knife, through the cornea, close to the sclerotica, and *prolapsing* a portion of the iris.

Since then, the operation, variously modified, has been practised with greater or less advantage in numerous cases. The additional step of *iridodesis*, or ligature of the prolapsed portion of iris, introduced by Mr. Critchett, has imparted greater precision and effect to the operation of dislocation of the pupil than that by simple prolapse.

The operation of dislocation of the pupil by prolapse and ligature of the iris will be described below, in the section on ARTIFICIAL PUPIL. Here, it is to be observed, that the pupil should, in general, be dislocated to opposite the lower and inner part of the cornea, that it should be entirely withdrawn from behind the apex of the cone, and that it should be made rather small, by prolapsing a considerable portion of the iris.

The reduction of the pupil to a slit in the direction and of the whole length of the vertical diameter of the cornea, by prolapsing the iris at its upper and lower margins, though it provides for an improvement in the definition with which vertical lines are seen, leaves horizontal lines as indistinctly seen as before. The reduction of the pupil to a horizontal slit by prolapsing the iris at the inner and outer margins of the cornea, on the other hand, though it provides for horizontal lines being better seen, leaves the vision of vertical lines as confused as before.

2nd.—*Hydrophthalmia.*

The cornea is more increased in diameter than in prominence, and may be either still transparent, or cloudy, or opaque.

The sclerotica where it joins the cornea is distended.

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* "A Practical Work on the Diseases of the Eye," &c. Vol. i. p. 277. London, 1840.

thin, and of a bluish colour. The conjunctiva is pervaded by enlarged and tortuous vessels.

The iris is more or less affected. It has a dull appearance, is perhaps inclined forwards, or found to be tremulous. The pupil is usually in a middle state between contraction and dilatation, and is motionless. In the course of the disease, the iris contracts adhesions to the crystalline body, which will probably be found opaque.

The eyeball is hard to the touch, except in an advanced stage, when it is often soft from commencing atrophy.

The patient experiences an uneasy feeling of distension in the eyeball, which he moves about in the orbit with difficulty in proportion to its enlargement. Muscæ float before the eyes, and amaurotic dimness of vision succeeds to short-sightedness. Total blindness may at last result.

Causes.—A cachectic state of constitution is a predisposing cause of the hydrophthalmia under notice. Its exciting cause is sometimes an injury, but in general its ætiology is obscure. Though the disease may not be unconnected with some degree of inflammation in its origin, it is not so obviously and regularly so, as to bring it under the last section of the preceding chapter.

Prognosis.—This is in general unfavourable. The disease may remain stationary, with vision much impaired; or the eye may become atrophied, or still more enlarged —in either case with total blindness, and in the latter with severe pain.

From the great size the eyeball may attain, the disease has been named *Ox-eye*, or *Buphthalmos.* The eyeball, in this extreme degree of the disease, is protruded from the orbit, stretching the eyelids, and is usually more or less disorganised.

Treatment.—Not much can be done in the way of medicinal treatment. Should the disease be limited to one eye, and be attended by severe pain, and especially should the opposite eye begin to sympathise, it will be necessary to have recourse to the operation of abscission of the front of the eyeball, or excision of the whole.

Hydrophthalmia sometimes occurs congenitally. The cornea is at the same time opaque or cloudy.

Congenital hydrophthalmia, with opacity of the cornea, appears to be a sort of imperfect development as regards the opacity, or at least a retention of the fœtal character of the cornea; for in the fœtus the cornea is opaque, and becomes clear only towards the period of birth.

In some instances the cornea has, with the growth of the child, been found gradually to clear, and vision, though myopic, to be acquired. Mr. Ware[*] relates several such cases, three of which occurred in one family. In two of the children the opacity was quite removed in less than a year; in the third the transparency was not complete until the end of the second year. The corneæ remained very prominent, and the vision myopic. In another case both corneæ were large, prominent, and completely opaque at birth. At the end of nearly three years, the left cornea had become clear enough to allow the perception of large objects; the opacity of the right cornea, though diminished round the circumference, remained at the centre so as to obscure the greater part of the pupil. In a fifth case, similar to the preceding, improvement had, at the end of a year, proceeded so far in one eye that the circumference of the cornea was quite transparent, and the opacity so far diminished in the centre that the pupil could be seen. Improvement was less advanced in the other eye. It is worthy of remark, that in these cases, the clearing of the cornea proceeded from the circumference towards the centre, a course similar to what is observed in acquired opacity of the cornea.

3rd.—*Posterior sclerotic staphyloma, with myopia.*[†]

Posterior sclerotic staphyloma has its seat on the temporal side of the entrance of the optic nerve. The bulging sclerotica is lined by the retina and choroid—the latter in a state of atrophy.

The retina, in the region of the yellow spot, being thus spread out at an increased distance behind the lens, near-sightedness is a symptom in the case.

The eyeballs affected with posterior sclerotic staphyloma, in consequence of their elongation from behind forwards, are remarkably prominent. They are also sluggish in their movements, and sometimes fall into a state of divergent strabismus.

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[*] Observations on the Treatment of the Epiphora, &c., p. 285. London, 1818.

[†] Staphyloma scleroticæ posticum, of Scarpa. Sclerectasia posterior.

The characteristic ophthalmoscopical appearance, alluded to at p. 60, of a crescentic patch of whiteness, embracing in its concavity the papilla optica, usually at the temporal and lower side, is owing, we have seen, to an atrophied condition of the choroid at the place, along with a retraction of it from the temporal side of the papilla, permitting the white sclerotica to shine through the retina.

Before describing in further detail the characters of posterior sclerotic staphyloma, let us examine the state of the eye when so affected, as ascertained by *post mortem* examination.

Morbid anatomy.—The following dissection, by Scarpa, who first called attention to posterior sclerotic staphyloma, affords a good picture of the morbid anatomy of the disease in an advanced stage :—

The eye, which was taken from the body of a woman forty years of age, was of an oval form, and somewhat larger than that of the other side. On the posterior hemisphere, and to the temporal side of the entrance of the optic nerve, the sclerotica was bulged out like a small nut. As the cornea and humours were still clear, there appeared, on looking into the eye, held against the light, an unusual brightness at the fundus, owing to the transparency of that part of the sclerotica which was the seat of the staphyloma. When the eye was opened, the vitreous humour was found entirely fluid, and the crystalline lens somewhat yellowish, though not opaque.

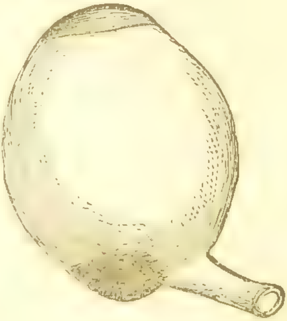

FIG. 57.

The bulging on the temporal side of the optic nerve is here seen, of a bluish-black.

The posterior hemisphere of the eyeball having been immersed in spirits of wine mixed with a few drops of nitrous acid, in order to give the retina consistence and opacity, it was distinctly perceived that there was a deficiency of that nervous expansion within the cavity of the staphyloma; that the choroid, very thin at this place, was destitute of its pigment and of its usual vascular network; and that the sclerotica, particularly at the apex of the staphyloma, was so thin as scarcely to equal the thickness of writing paper.

The woman had lost the sight of the eye some years before, during an obstinate ophthalmia, attended with severe pain in the head.

The inflammation, with which the eye had been affected, had been a posterior internal ophthalmia or sclerotico-choroiditis, whereby the sclerotica and choroid having become softened, yielded to the intra-ocular pressure occasioned by the increasing accumulation of vitreous fluid—this increasing accumulation of fluid being owing partly to the internal congestion and partly to the cessation of the natural resistance which should have been offered by the sclerotic to undue accumulation.

In this case, the retina had become destroyed at the place, but in the more common and less advanced degrees, the retina, although bulging out along with the sclerotica and choroid, continues to retain its structure and sensibility. Eventually, however, degenerations of it are liable to supervene in the region of the yellow spot, the part of the retina which commonly corresponds to the apex of the staphylomatous bulging.

The retraction of the choroid from the temporal side of the papilla and its atrophy in the region of the staphylomatous bulging of the sclerotica is a distinguishing feature of the disease. The atrophied choroid is usually closely applied, but not adherent to the sclerotica. Nothing of its structure is left at the place, but some remains of its large vessels and stromatic pigment. The membrane of the pigment and its capillary layer have disappeared.

Ophthalmoscopical appearances.—On examining an eye affected with posterior sclerotic staphyloma ophthalmoscopically by the inverted image process, we see on the temporal side really (but apparently on the nasal side) of the papilla optica, a crescentic shaped strongly reflecting whitish patch of sclerotic surface, left bare by the retracted and atrophied choroid, shining through the retina. (Fig. 58.)

In an advanced stage of the disease, the choroid having become atrophied to a greater extent, more of the white sclerotica is exposed.

The white patch of sclerotica, though generally on the temporal side of the papilla optica, has been met with at the upper side—never below. It has been found, though rarely, all round the papilla. In such cases, however, its greatest extent has still been on the temporal side (seen as if on the nasal side).

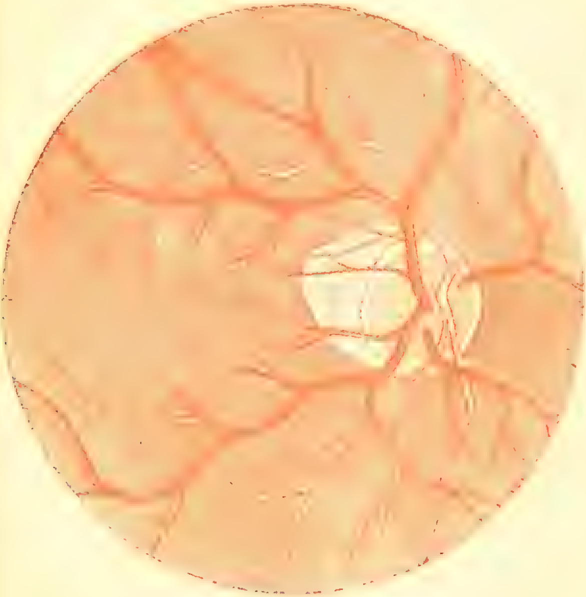

FIG. 58. **Inverted image in the left eye.**

The degree of the accompanying alteration in the form of the papilla optica is necessarily dependent on the situation and extent of the staphyloma.

The papilla optica, by being involved in the bulging out of the sclerotica, acquires an oblique position, so that when viewed with the ophthalmoscope, it appears oval, as a circular surface does when viewed obliquely. But besides this apparent shortening, usually of the transverse diameter of the papilla, there is a real shortening on which the oval outline of the papilla also depends. (See Fig. 21, p. 60.)

The surface of the papilla is more or less excavated. The retina at the place corresponding to the atrophied choroid and bulging sclerotica having undergone some extension, its vessels, although still seen there very disinctly, may not be so tortuous as usual.

Besides the changes of structure indicated by the ophthalmoscopical appearances just described, which are the most characteristic of posterior sclerotic staphyloma, others, the effect of the posterior internal ophthalmia, may eventually be met with, such as extravasation of blood, deposits of pigment, white opacities of the retina in the region of the yellow spot, detachment of the retina from the choroid by effused serum, grayish flakes in the vitreous humour, &c. In more advanced stages, opacity of the lens may occur.

Causes.—A predisposition to posterior sclerotic staphyloma appears to have its origin or starting-point in the persistence of a fœtal condition of the eye pointed out in the middle of last century by Professor Brendel of Goettingen, and more particularly described by Dr. Von Ammon in his "Questio anatomico-physiologica de genesi et usu maculæ luteæ in retinà oculi humani obviæ." (Vinariæ, 1830, 4to.), viz., a protuberance or bulging which the sclerotica here presents.

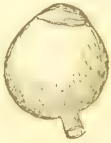

FIG. 59.

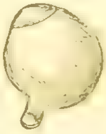

FIG. 60.

The right and left eyeballs of a seven-months' fœtus, showing the sclerotic protuberance.

Parts arrested in development are afterwards always more ready to run into disease or degeneration. In such a case, the undeveloped sclerotica and corresponding part of the choroid readily become congested, and the bulging will pass into actual staphyloma, which will go on gradually to increase, for posterior sclerotic staphyloma, when once begun, does not always remain stationary.

It is to be remarked that the congestion of the choroid adjacent to the atrophied part of it, is the result of the stoppage of the circulation in the atrophied part, not the cause.

State of Sight.—In advanced degrees of posterior sclerotic staphyloma, in consequence of the retina becoming implicated, to the extreme near-sightedness characteristic of this state of the eye, there is superadded amblyopia, muscæ volitantes, photopsy.

The patient complains that he can no longer see distinctly to read and write. There is a glimmering dimness over the letters, which appear as if broken or deficient here and there. Straight lines may appear as if curved, owing to the unevenness with which the retina is spread out in the region of the yellow spot.

The still sensitive part of the retina having become very circumscribed, the field of view is proportionally reduced, so that the patient in reading can see a word or two at a time, only if the print be small; but if large, a letter or two only at a time. Even this small amount of sight may be suddenly lost by further implication of the retina from effusion of blood, or some other deteriorating cause in the region of the yellow spot.

Fixed muscæ are seen owing to insensible spots of the retina arising from atrophy, detachment from serous or bloody effusion, extravasation of blood into the tissue of the retina, or the like.

Treatment.—The attending near-sightedness is to be corrected by the use of appropriate concave glasses. See infra, MYOPIA.

As there is a tendency to internal congestion, great care should be taken to guard against a stooping position, and prolonged exertion of the sight.

The inflammation which is liable to supervene, is sclerotico-choroiditis or posterior internal ophthalmia with serous effusion (p. 233).

4th.—*Detachment of the retina from the choroid by serous effusion between the two membranes.**

The form of hydrophthalmia here to be noticed is that in which there is effusion of fluid between the choroid and retina, separating the latter from the former, and causing it to bulge forward in the vitreous humour, now in a dissolved state.

By means of the ophthalmoscope, and even by oblique illumination,—this bulging forward, as also a tremulous undulating movement of the retina, with dark-coloured veins, apparently broken in their course on its surface, is distinctly seen in the dissolved vitreous body, as represented in the annexed figure, reproduced from p. 58.

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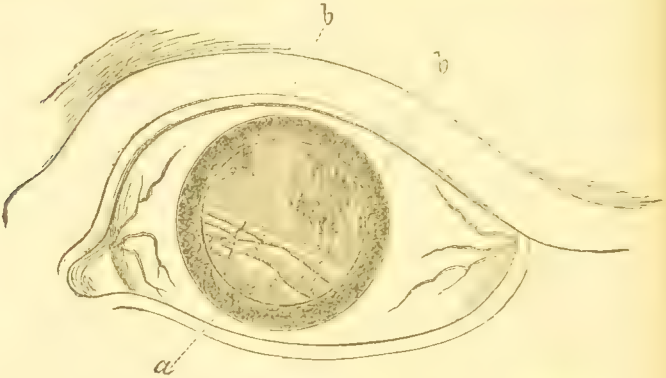
* Sub-retinal dropsy.



a. The bulging retina. *b b.* Deposits of pigment.

FIG. $\frac{19}{61}$.

Sometimes the detached retina presents small patches of extravasated blood.

As above stated (p. 58), it is the lower half of the retina which is most commonly found detached. In more advanced cases, the detachment extends upwards on either side of the papilla. The inner and upper parts of the retina remain longer unaffected. Visual sensibility may be still possessed by the undetached portion of the retina.

By the pressure of the increasing accumulation of fluid between the choroid and retina, the vitreous humour is liable eventually to become wholly absorbed. The result is coarctation of the retina into the form of a funnel, having its base at the lens, and its apex at the entrance of the optic nerve. The retina thus crumpled together appears as an opaque body behind the dilated pupil, and has been mistaken sometimes for cataract, sometimes for fungous disease of the eye.

Detachment of the retina by serous effusion between it and the choroid often comes on without any other symptom than that the patient finds he cannot see the upper part of the field of view, perhaps, and that what he sees adjacent to this appears curved, broken, or askew. When the separation is more extensive, the field of view is correspondingly reduced.

There can be no doubt that in some cases the loss of sight has come on suddenly, from which it is to be inferred that the effusion causing detachment of the retina has been of sudden occurrence. In other cases, the patient having discovered the loss of sight of the eye only by chance, there is no knowing how long it may previously have existed.

Sometimes when first detected, the defect of sight and the detachment of the retina on which it depends are not great.

The progress of the separation of the retina may come to a standstill, and consequently the further impairment of the sight, but this is usually only for a time. An increased effusion of serum and further separation with corresponding loss of sight eventually take place, sometimes slowly, sometimes quickly.

Some degree of softening of the eyeball often co-exists.

Though there is not any symptom of inflammation at first, posterior internal ophthalmia in a marked degree may supervene and hasten on the disease to the advanced stage above described, in which the whole retina is crumpled together into a cord extending from the papilla to the ciliary zone.

One eye being affected, there is reason to fear that the other will share the same fate.

Cases illustrative of the symptoms and diagnosis.—A lady, æt. 68, relates that four months ago the glass fell out of the right eye of her spectacles, whereupon she discovered that she could not see with the left eye. She had not had previously any pain over the eyebrow or in the eye, or indeed any sensation to direct attention to the left eye. Used to be subject to biliousness. Has had sciatica. Is of a gouty family, and has gouty enlargements of the joints of the fingers. Has suffered from piles. Has been otherwise healthy.

When the defect of sight was first discovered, the left eye could still see outwards. Gradually the dimness spread all over the field, except a little of the lower part, which can still be seen on throwing the head backwards.

An undulating luminous appearance is seen before the left eye, even when shut.

Pupil of the left eye sluggish; that of the right active.

The pupil of the left eye having been dilated by atropia, I found, on examination with the ophthalmoscope, that the lower and temporal half of the retina was pushed forward into the vitreous humour, appearing as a greyish semi-transparent undulating film, with dark vessels on it.

Some months after the consultation and examination of the left eye now mentioned, I again saw the lady on account of an attack of erysipelatous inflammation of the right eye. This ophthalmia duly subsided under the requisite treatment. The left eye continued as before. On seeing the elevation of the conjunctiva by serous effusion behind it, the idea of an analogy with the separation of the retina in the other eye by serous effusion between it and the choroid could not help occurring to my mind.

A lady, æt. 38, relates that about six months ago she noticed crowds of motes like grains of soaked sago floating before the right eye. Of late some small dark specks have appeared among them. The motes appear lighter in the dark.

Within the last two or three weeks, discovered that the sight of the right eye is so imperfect that she cannot see anything except what is seated to the right and below.

About two or three months ago the eye was accidentally struck by her husband's elbow.

Pupil of right eye small and very sluggish. That of the left, natural. Sight of the left eye good.

Subject to headaches, and has often had pains in the right eye extending to the back of the head. Has had hæmoptysis.

The pupil having been dilated by atropia, the extent of the field of vision was enlarged.

On examination with the ophthalmoscope, I found the upper and left half of the fundus natural, but the retina pushed forward from the lower and right half. The detached retina was bluish-white, with vessels on its surface.

A gentleman cannot see with his right eye objects distinctly in the upper part of the field of view. Sees them askew, and observes an undulating coloured corruscation before the eye.

Discovered this defect of the sight of the right eye two or three years ago by not being able to get sight of the bird with it, when out rook-shooting one day. The sight has been gradually becoming slightly more impaired than it was when the defect was first noticed.

Causes.—Reference has been above (p. 64) made to the case of a gentleman who had one eye hypermetropic, the other myopic, and who lost the sight of the latter eye in consequence of separation of the retina by serous effusion between it and the choroid. This is an event very liable to happen in advanced cases of posterior sclerotic staphyloma such as this was. Dr. Donders relates a curious case of a girl aged 15, affected with a high degree of myopia, suddenly crying out with joy that she could recognise the people at the other side of the street. But her joy was of short duration, for in three days the eye had become quite blind from complete detachment of the retina. The temporary farsightedness had been owing to the retina not having at once lost its sensibility at the time that it was detached, and to its being pushed forward by the effusion to a position to receive the focus of parallel or slightly divergent rays.

The projection of the retina forward indicates diminution in the quantity of vitreous body, and the undulatory movements of the folds of the retina indicate that the vitreous is in a fluid state.

Atrophy of the vitreous body is a condition, therefore, which must precede well marked detachment of the retina from the choroid.

Blows on the eye, erysipelas of the face, albuminuria, &c., have appeared in some cases to have been the cause of detachment of the retina.

Prognosis.—This is in the highest degree unfavourable.

General treatment.—The removal of any posterior internal congestion that may exist, is the means we must look to, for arresting further effusion between the choroid and retina, and promoting the absorption of what may have taken place. But it is only in a very early stage of the disease that we can venture to entertain hopes of such an event.

Treatment by operation.—In the cases in which there is already coarctation of the retina, with the atrophied vitreous body within, and accumulation of fluid without, causing great distension and pain, evacuation of the fluid by puncture of the sclerotica and choroid about half an inch behind the margin of the cornea, has been had recourse to with advantage for the purpose of relieving the distension and pain, but not with any expectation of restoring sight.

In the less advanced cases of partial detachment, an operation has recently been tried, which consists in making an opening in the detached retina by puncture, so as to permit the sub-retinal fluid to mingle with the vitreous, in the hope that then the retina might fall back again into apposition with the choroid. In this case, it will be observed that it is not the object to give issue to the sub-retinal fluid, though evacuation of some may take place in the course of the operation.

Spontaneous perforation of the detached retina has been sometimes found to have taken place with the apparent effect of arresting the progress of the detachment. Such cases give encouragement to this operation of puncturing the detached retina.

The actual result of the operation in some cases has been the falling back of the retina more or less closely into apposition with the choroid, and improvement of the sight as respects extent of field and clearness of perception. This improvement, however, has often not been permanent.

Still, no bad effect has followed the operation, either as regards undue inflammation or further deterioration of sight. Of course, as long as an eye is serviceable, we ought not to think of operating.

Mr. Bowman has published some cases in which he operated by puncturing the retina from behind forward, and then slitting or tearing it up. Dr. von Graefe, the original author of the operation, has relinquished this mode of procedure, thinking that it involves greater risk of mechanically increasing the detachment and even of wounding the posterior surface of the lens, while the movements of the needle are much less effective than when, on an opposite principle, the retina is divided from before backwards. The instrument Dr. von Graefe employs is a double-edged sharp-cutting needle, with the neck thick enough to fill the wound so as to prevent the escape externally of the fluid.

The pupil is to be brought under the influence of atropia, and the eye firmly fixed.

For the wound it is best to choose a point on the outer hemisphere, unless the situation of the detachment demands otherwise, for whilst the retina should be divided from before backwards, the puncture should be made in the meridian, corresponding to the most prominent part of the detachment. The needle is entered at the distance of from four to five lines behind the corneal margin, and pushed on perpendicularly in the vitreous chamber for about half an inch. The point of the needle is then to be directed towards the fundus by a lever movement of its handle forwards. One of its edges being then turned against the detached retina, the projecting part of that membrane is divided in the act of withdrawing the instrument. Care is to be taken not to wound the choroid.

In reference to the principle of this operation, it is to be observed that the vitreous body being in cases of detached retina, atrophic and fluid, any falling back of the retina into apposition with the choroid must depend in a great measure on the circumstance whether or no diffusion of the sub-retinal fluid takes place into the vitreous.

5th.—*Hæmophthalmus.*

Extravasation of blood under the conjunctiva has been named *Hæmophthalmus externus*, in contradistinction to effusion of blood within the eye, which has been named *Hæmophthalmus internus.*

Hæmophthalmus externus, called also *conjunctival ecchymosis*, may be occasioned by various causes, such as blows on the eye or its neighbourhood, efforts, purpura. Its occurrence in connection with inflammation, has been above noticed (p. 106). Sometimes it occurs without any evident cause.

Treatment.—Left to itself, the blood is gradually absorbed; but the absorption appears to be hastened by the application of some irritating collyrium to the conjunctiva.

Effusion of blood *within* the eye falls to be considered under the two heads of *Hæmophthalmus internus anterior* and *Hæmophthalmus internus posterior.**

Hæmophthalmus internus anterior.—The appearance presented in hæmophthalmus internus anterior, is blood, in greater or less quantity, in the anterior chamber. (*Hypohæma*).

Hæmophthalmus internus anterior, when not the immediate result of injury or operation, most generally occurs in eyes already in an unhealthy state from previous injury or inflammation. It sometimes supervenes in the course of internal ophthalmia (p. 123); and in cases of females affected at the same time with amenorrhœa, it has been observed to recur about the menstrual period. Hæmophthalmus internus may take place in consequence of unusual bodily exertion—no evident cause operating directly on the eye—and afterwards recur repeatedly and even periodically. In purpura hæmorrhagica, an effusion of blood has occurred within both eyes.

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* General extravasation of blood in the eye from injury will be considered below under the head of Injuries of the Eye.

Treatment.—The effused blood is in general readily absorbed, and considered by itself alone, requires no interference, unless the chambers of the eye be very much distended, when a puncture of the cornea may be required to give it issue.

Hæmophthalmus internus posterior.—In the forms of hæmophthalmus just described, the effused blood is seen at a glance. Besides these, however, extravasations occur at the bottom of the eye. A symptom of this is sudden failure of sight, which is occasioned either by pressure on the retina, or, the extravasation being in the vitreous humour, by the obstruction to the passage of the light.

Such extravasations are objectively recognised only by means of the ophthalmoscope (pp. 55, 60, 124, et seq.).

As conjunctival ecchymosis sometimes presents itself in connection with inflammation, sometimes without any evident cause (p. 309), so the extravasations, just referred to, come on: some in the course of posterior internal inflammation—some, without any apparent cause, acting on the eye.

Externally, the eye may seem unaltered, and the pupil moveable.

The patient suddenly finds the field of vision obscured either in whole or in part—perhaps in the morning in getting up. He may have previously had pains in the head, pain and weight in the eye, and transient disturbance of sight. He may have previously been making great bodily exertion, or have had a fit of vomiting.

On investigating the state of health of the patient, some general complaint, such as disease of the heart, will probably be discovered predisposing to the extravasations. Extensive extravasations with failure of sight—often occurring suddenly in heart disease—constitute what has been called *apoplexy* of the retina.

Extravasation in the vitreous humour.—This may sometimes be detected by oblique illumination without the aid of the ophthalmoscope.

Under the ophthalmoscope a deep-seated dark-brown opacity, denser at the lower part of the eyeball, intervenes to prevent the fundus being seen. After absorption has taken place to some degree, the fundus becomes visible, but there may remain flakes and filaments of a rusty yellow or dark red-brown colour suspended in the vitreous.

The subjective appearance to the patient is as if there was a dark ball of a reddish or greenish tinge in the field of vision.

Extravasations of blood implicating the retina.—These may have their seat on its anterior surface or in its substance, and usually present themselves around the pupilla and in the course of venous ramifications.

After a time, the spots of extravasation become altered in appearance, assuming a reddish-brown colour at the circumference, and may become surrounded with a whitish border from exudation.

Fig. 1, Table VIII., of Liebreich's *Atlas der Ophthalmoscopie*, represents a case of hæmorrhage of the retina in a man of 71, with arterio-sclerosis and hypertrophy of the left ventricle.

The patient found, on waking one morning, the sight of the left eye gone. Fourteen days after, when he consulted Dr. Liebreich, he could only with difficulty distinguish fingers held before him, to one side. Under the ophthalmoscope, irregular ecchymoses, which appeared to implicate all the layers of the retina, were seen at the bottom of the eye, and extending to the circumference. Among the large patches small red points of extravasation were interspersed.

The arteries appeared in some parts quite empty of blood, and changed into whitish cords; in other parts, they were filled with coagula at intervals. The circulation was free only in some branches. The veins also were for the most part empty of blood. Only one branch presented any appearance of being normally filled.

In old persons, absorption of extravasated blood is very slow of taking place, and with the vessels in such a state as they were in this case, it is never complete.

Fig. 3 of the same plate represents hæmorrhage and fatty degeneration of the retina in a case of arterio-sclerosis and hypertrophy of the left ventricle.

The patient, a man aged 64, had been labouring for a period of four years under a high degree of amblyopia, steadily increasing. The retinal arteries were slender, and some quite obliterated. The veins were, in some parts of their course, elongated and nearly empty of blood, while the small branches were distended and tortuous. Small striated extravasations were seen in the nervous layer, and a large smooth extravasation on the inside of the retina. There was an extension of extravasation into the vitreous, where the blood had become black. The white spots of the retina were probably produced partly by fatty degeneration, partly by sclerosis of the nerve-fibres.

The patient died of apoplexy.

Fig. 2 of the same plate represents a case of hæmorrhage of the retina in consequence of cessation of the menses.

A woman, 45 years of age, used to menstruate copiously. After the menses had ceased, she one day suddenly felt as if something had come over the left eye, obscuring the middle of the field, but leaving the circumference clear. She had at the same time buzzing in the ears, vertigo, and nausea for some hours.

On making an ophthalmoscopic examination five days after, several small round extravasations were observed in the posterior nerve-stratum of the retina, and striated ones in the anterior nerve-stratum. In the region of the yellow spot there was a large extravasation in the posterior nerve-stratum. This spot, of the shape of half an oval, was completed into a whole oval by an opaque condition of the adjacent part of the retina, supposed by Liebreich to be owing to effusion of a clear fluid between the retina and choroid.

Under derivative treatment, the smaller extravasations and this watery effusion became absorbed in the course of a few weeks. The large extravasation disappeared in the course of some months, being absorbed from periphery to centre. The sight improved in proportion. Eventually the extravasations all disappeared, and the sight became as good as before.

Choroidal extravasations of blood.—Here the ecchymotic patches, which are more or less diffused, are seen lying behind the level of the retinal vessels. They may be seated at the surface, in the substance, or behind the choroid.

At first they are dark red in the centre, and brighter at the edges. After a time they are found to be yellowish or light brown. As the blood is absorbed, the part of the choroid involved becomes atrophied, and the sclerotica appears through as a white spot. The edges of the adjacent still unaffected part of the choroid are very dark from an increased deposit of pigment.

Extravasations of blood from the choroid sometimes break through the retina into the vitreous.

Prognosis.—Although the blood in posterior internal hæmophthalmus may be absorbed, and the sight recovered, new extravasations are always liable to take place; and this constitutes the great danger of the complaint, for disorganisation of the vitreous, retina, and choroid, is the eventual result of frequent attacks.

Treatment.—If the hæmophthalmus be dependent on inflammation, the treatment of the latter is the proper treatment of the former. If dependent on some general complaint, that is to be attended to. But in any case the treatment should comprise rest, leeches in the neighbourhood of the eye, cold applications, and aperients.

To the account of hæmophthalmus now given, I add, by way of postscript, the following case of disease of the kidneys, with extravasations of blood in various organs, but especially in and around the eyes.

A sempstress, aged 19, was admitted into University College Hospital, with great protrusion of the left eyeball, over which the upper lid, livid from ecchymosis, was tensely stretched. The ocular conjunctiva was raised up in the form of chemosis by extravasated blood, and protruded between the eyelids. The sight was totally lost. The protrusion of the eyeball and loss of sight came on two days before admission. The right eye was not affected. The patient was very pale-looking.

Past history of the case, drawn up by Mr. Ringrose, ophthalmic surgeon's assistant.—About two months ago, both eyes became bloodshot. The left was the first affected, but whilst it got well the vision of the right remained dim. For this the patient was treated at a public institution, but without benefit.

Has been subject to bleeding from the nose since childhood, and about a month ago lost a great deal of blood in this manner. Menstrual discharge first appeared when she was between sixteen and seventeen years old, and was very profuse, but latterly it has not been nearly so much. Has suffered from headaches for the last three or four years, chiefly over the brow; but lately the pain has extended to the back of the head.

Has been subject to cold feet, and has frequently fainted at her work. The urine has been very high-coloured, with a thick sediment at the bottom of the utensil. She has frequently complained of pain across the loins. Parents are both healthy.

When I first saw the patient the day after her admission, I found that the right eye had become slightly affected also.

I incised the chemosed and protruding ocular conjunctiva of the left eye, and likewise slit up the upper eyelid to relieve the eyeball from the pressure it was subjected to. This immediately afforded the patient considerable relief.

The following day's report states that the patient does not suffer so much pain and has had a tolerable night, but complains of dimness of sight of right eye.

Next night difficulty of breathing came on, and at my visit the following day I found the patient blind of both eyes.

The difficulty of breathing went on increasing, and death took place the same night.

On examination of the body after death, which was conducted by Dr. Ringer, ecchymoses were found in the skin of the arms and legs, the dura mater, the lungs, the heart, the aorta, and spleen.

The kidneys were natural in size, but of lighter colour than usual. The capsule peeled off much too easily. On section, the cortical substance was found much atrophied. Under the microscope, fatty degeneration, atrophy of the Malpighian bodies, and an increased amount of fibrous tissue, were observed. The urine drawn from the bladder after death, showed a considerable quantity of albumen.

The following were the results of the dissection I made of the eyes:—

Left eye.—There was extravasation of blood in the cellular tissue between the ocular capsule and sclerotica, and between the sclerotica and conjunctiva. There was also ecchymosis in the substance of the upper eyelid next the tarsus. On examination of the exterior of the eyeball, points of extravasations were seen at the exit of the venæ vorticosæ. Extravasated blood was found between the sclerotic and choroid; and there was serous effusion between the choroid and retina, in consequence of which the retina was pressed together into a string of folds, whilst the vitreous humour had become absorbed. The inside of the retina, both at its fundus and anteriorly, presented spots of extravasated blood. The lens, iris, and cornea were not much altered. There was no extravasation in the optic nerve.

Right eye.—The sight of this eye, as above mentioned, was quite lost before death. There was no protrusion, and no extravasation within the ocular capsule; but there was slight extravasation at the points of exit of the venæ vorticosæ, as in the left eye. As in the left eye also, there was extravasation between the sclerotic and choroid, though in a less degree. There was also serous effusion between the choroid and retina, but the retina was not pressed together as in the left eye. Extravasated spots were observed on the inner surface of the retina at its fundus. The vitreous humour was yellowish from slight intermixture with extravasated blood.

6th.—*Hydatid* (*cysticercus cellulosæ*) *within the eyeball.**

At the time when the last edition of this treatise was published, five cases at least, in which a living hydatid, floating free in the aqueous humour, was observed, had been recorded. In a sixth case, a hydatid was discharged through an incision in the cornea, made for the purpose of evacuating the aqueous humour; but its existence, while actually within the eye, was not recognised, in consequence of opacity of the cornea from chronic inflammation.

In the first case, which is recorded by Dr. W. Soemmering (Isis von Oken, 1830), and the subject of which was a healthy girl of eighteen, the hydatid was discovered soon after an ophthalmia. The subject of the second case, which occurred in 1833, and which was first described by Mr. Logan, subsequently by Dr. Mackenzie (Med. Gaz. vol. xii., and Treatise, &c.), was a healthy-looking girl, seven years of age. In this, as in Soemmering's case, the hydatid appeared after ophthalmia, in consequence of which there was slight opacity of the cornea.

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* Hydatids in the cellular substance of the eyelids, and under the conjunctiva, are spoken of below.

This latter case I had the opportunity of examining and attending after the operation. The tail-vesicle of the animal was about one-sixth of an inch in diameter, semi-transparent, and might be seen sometimes contracting, sometimes expanding, and at the same time undergoing slight changes of form. The body and head were sometimes retracted within, sometimes protruded from the tail-vesicle, the part of which connected with the body and head was always the most depending. When the body and head were protruded, and hanging downwards, the animal resembled a miniature balloon. Fig. 1, Pl. V.

The third case is thus described by Dr. Mackenzie,* in whose practice it occurred:—

Elizabeth Gordon, aged sixteen years, applied at the Glasgow Eye Infirmary, on the 26th September, 1848, on account of obscurity of vision in her left eye. In the anterior chamber, close in front of the pupil, which, in a bright light, it completely covered, lay a spherical body, about one-eighth of an inch in diameter, semi-transparent, and having a good deal the appearance, at first view, of the nucleus of the crystalline lens. On observing it for some little time it was evident that it was a vesicle, changing occasionally its form and position, and protruding at times from its lower edge an opaque white filament. The part first mentioned was, in fact, the tail-vesicle of a cysticercus cellulosæ, and the latter its body and head. The head was seen to be occasionally thrust down nearly to the bottom of the anterior chamber, and then drawn up completely into the tail-vesicle.

The patient stated, that about the middle of June the left eye had been affected with inflammation, which continued for about three weeks, and was removed after the application of a poultice of rotten apples, immediately after which the hydatid was noticed.

She seemed in good health, but stated that she had never been robust, and when a child had been troubled with ascarides and lumbrici.

In general the patient made no complaint of pain. Of the motions of the hydatid she was quite unconscious.

The fourth case also occurred to Dr. Mackenzie shortly after the preceding. The subject was a man from the north of England.

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* Case of cysticercus cellulosæ, in the anterior chamber of the human eye. In Med.-Chir. Trans. vol. xxxii. 1849.

The fifth case occurred to Dr. A. von Graefe, of Berlin.

The sixth case occurred about twenty years ago, at the Westminster Ophthalmic Hospital, and the hydatid, after extraction, was brought to me by Mr. Canton for examination, to whose kindness I am indebted also for having subsequently had an opportunity of seeing the patient, who was a boy about ten years of age. I found the cornea semi-opaque and vascular, and increased both in diameter and prominence.

The hydatid in this case was more than double the size of that in the preceding, and its appearance at first sight suggested the idea, that it was the lens and vitreous body—the former opaque and contracted, the latter shrivelled, by the draining away of the contained humour; but a slight examination of the body was sufficient to point to its true nature, which a microscopical dissection confirmed.

Treatment.—In Soemmering's case uneasiness was experienced from the presence of the animal in the eye only when it moved. Increasing in size, however, it was removed by Dr. Schott, who, having made a small section of the cornea, introduced a pair of hooked forceps into the anterior chamber, seized the hydatid, and extracted it alive.

In Mr. Logan's case, no uneasiness was at first experienced, but subsequently pain and redness of the eye setting in, an attempt was made by Dr. Robertson, of Edinburgh, to extract the animal. In consequence, however, of the unsteadiness of the child, the operation did not turn out well; the lens escaped, the iris protruded, and the hydatid was ruptured, but the shreds of it were eventually removed. After the operation, I attended the case in Dr. Robertson's absence. The eye healed, with a broad cicatrice of the cornea, and the pupil remained contracted, distorted, and obstructed with opaque capsule.

In operating on Elizabeth Gordon, Dr. Mackenzie imitated the plan followed by Dr. Schott in Soemmering's case, except that he used Schlagintweit's hook instead of forceps for seizing the hydatid.

"I made," says Dr. M., "a puncture with Beer's pyramidal knife, at the temporal edge of the cornea, to the extent of $\frac{3}{20}$ of an inch. A little of the aqueous humour escaping as I withdrew the knife, the tail-vesicle of the hydatid became flattened and much expanded between the iris and cornea. I immediately passed Schlagintweit's hook through the wound, seized the body of the hydatid with it, and easily withdrew the animal entire. The iris protruded somewhat through the wound, but was readily reduced by friction through the medium of the upper eyelid, so that the pupil resumed its natural form and place. The patient was sent to bed, and ordered to keep her eyes shut, and the left eye covered with a wet rag.

"Next day the patient felt quite well; the eye appeared natural, and she said she saw as well with it as with the other. No reaction followed, and she was dismissed on the 21st October."

In the treatment of his second case, Dr. Mackenzie followed the same plan, and was equally successful.

More recently, a similar case has been recorded by Mr. Windsor, of Manchester.

A case of cysticercus between the lamellæ of the cornea was published by Dr. Appia, of Geneva, in 1853.*

Cysticercus cellulosæ deep in the eye.—Dr. Von Græfe has related four cases in which, by means of the ophthalmoscope, he detected a cysticercus deep in the eye. In one of these cases the hydatid was in the vitreous humour behind the lens; in the other three it lay on the retina, and destroyed vision. See above, p. 59.

Fig. 5, Plate VII., of Liebreich's Atlas, represents a cysticercus in the vitreous body. The hydatid was supposed to have been developed behind the retina, and afterwards to have broken through that membrane into the place where it was found.

The movements and coarctations of the tail-vesicle were seen with the ophthalmoscope, and the red bottom of the eye through the more transparent middle part. The neck was opaque, and beset with white sparkling points. Liebreich extracted the cysticercus in such a case. With an ophthalmoscope fixed to his head, he introduced a canula-forceps through a puncture in the sclerotica, seized the animal by its firm neck, and drew it out. The small grey circular spots seen partly surrounding the tail-vesicle, are partial opacities of the vitreous.

In Fig. 6 of the same plate, a cysticercus is represented lying behind the retina. This position of the hydatid was evident from the retinal vessels seen passing over it.

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* See Archives d'Ophthalmologie. Paris, 1853.

In horses in India, during the cold season, a species of filaria, or thread-worm, about an inch long, and whitish, moving freely about in the anterior chamber, is not unfrequently observed. In horses in Europe, instances of the same thing, though not unknown, are rare. The worm, unless extracted, excites inflammation of the eye, with dimness of the cornea. Extraction is effected through a small incision of the cornea, the aqueous humour, as it escapes, carrying the animal along with it.

No instance is known of a filaria in the anterior chamber of the human eye, but filariæ have been met with in cataractous lenses,* after extraction, as also monostomata and distomata. These, however, were not recognizable while within the eye, having been discovered only on minute examination of the extracted lens with magnifying glasses. They do not appear to be of any practical consequence.

7th.—*Cysts in connection with the iris.*

In one case, a cyst, of the size of a small pea, and glistening like tendon, formed in connection with the iris of a boy, an apprentice to a blacksmith, some months after severe inflammation, produced by a small particle of hot iron, which penetrated the cornea and lodged in the iris. In another case, the subject of which was a girl, about nine years of age, a similar disease occurred a few months after inflammation, brought on by the eye being struck with some bearded corn. *In both cases the cyst was removed by operation.* In the first case the patient did not retain useful vision afterwards. In the second, iritis came on, to which was soon joined sympathetic iritis in the other eye. The inflammation was eventually stopped, and the eye secondarily affected recovered; but that on which the operation had been performed retained the power to perceive large objects only.†

In a third case, a lady was affected with considerable pain in one of her eyes, which, on examination, presented a small vesicle protruding from the posterior into the bottom of the anterior chamber, under the ciliary margin of the iris. (Figure 3, Plate V.) The vesicle gradually increased, separating the iris more and more from the choroid, and the pain became severe. *The vesicle or encysted tumour was punctured with the iris knife through the cornea.* A minute quantity of fluid was discharged from the cyst, which immediately contracted so much that it was no longer visible, The pain was removed. The cyst, however, filled again with fluid, and again appeared in its former situation, but larger than before. *It was punctured a second and a third time at intervals of six and eight weeks.* After the third puncture it did not fill again. The iris returned to its natural place; the pain ceased entirely; and vision was preserved.*

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* As will be mentioned below, a species of filaria has also been found under the conjunctiva of the human eye.

† Tyrrell's Practical Work on the Eye, vol. i. pp. 368, et seq.

A boy, about five years old, was received into University College Hospital, with a cyst in the left eye, similar to the preceding. It protruded from the posterior into the anterior chamber, the lower part of the iris having become detached from its ciliary connection, and pushed upwards.

About a year and a half before, the child accidentally thrust the point of a fork into the left eye. From the immediate effects of this injury recovery took place in about three weeks. A small opacity at the lower margin of the cornea, close to its junction with the sclerotica, indicated where the wound had been inflicted. From that time the eye continued well until about two months before his admission into the hospital, when an attack of inflammation came on, attended by intolerance of light and lacrymation.

The cyst was punctured through the cornea, and a considerable quantity of fluid evacuated, whereupon the delicate wall fell collapsed to the bottom of the anterior chamber, while from day to day the detached portion of iris regained its natural position, and the pupil its form and size.

Some time after, however, about six weeks from the time the first puncture was made, the cyst had again filled, so that it was considered advisable to repeat the operation. Three or four days after this, inflammation came on, and a small quantity of yellow matter appeared at the bottom of the collapsed cyst. The inflammation and deposit of matter having increased, leeches and warm fomentations to the eye, and small doses of calomel three times a day, were ordered. The inflammation now subsided, and the matter of the cyst worked its way outwards, and some of it was evacuated at the junction of the cornea and sclerotica by a narrow outlet, a mode of evacuation of matter from the anterior chamber, such as I have seen before in cases of iritis, with abscess at the ciliary margin of the iris. After this, the cyst collapsed, and, together with the rest of the matter, gradually disappeared to a mere trace at the bottom of the anterior chamber. The pupil regained its natural size and form, and the sight was perfectly retained.

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* Mackenzie's Practical Treatise on the Diseases of the Eye. 3rd ed. p. 604.

Analogous to the cysts just described, or identical with them, except in the place where they show themselves by protrusion, is the collection of fluid within a very small circumscribed sclerotic staphylomatous projection, sometimes met with in the region of the ciliary body, close to the margin of the cornea.

8th.—*Non-malignant tumours of the eyeball.*

Various kinds of growths are met with, sometimes connected with the sclerotica and cornea,* sometimes with the iris, sometimes with the ciliary body and choroid, sometimes with the retina and the vitreous body.

In regard to non-malignant growths connected with the choroid, retina, and vitreous body, it is to be observed, hat they give rise to a yellow shining metallic appearance, sometimes traversed by bloodvessels, at the bottom of the eye. In cases of effusion between the sclerotica and choroid, the ophthalmoscopic appearance is a small, sharply-defined reddish-yellow globular tumour, pushing forward in the vitreous body, on which, without any deviation in their course, the retinal vessels are seen. There is no folding or undulating movement as in simple retinal detachment from the choroid, though such may coexist.

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* See, in the Archives d'Ophthalmologie, Mars et Avril, 1855, 'Description d'une espèce particulière de Tumeur de la chambre nterieure, qui a pour origine l'hypergénèse de quelque éléments de a Cornée. Par MM. les Docteurs Desmarres et Ch. Robin."

The sclerotica and cornea are more or less involved in the growths and tumours of the ocular conjunctiva. See below.

A similar appearance is presented in incipient cases of medullary fungus of the retina. Sometimes in consequence of injury of the eyeball, a shining yellow surface is seen at the bottom. In deep-seated scrofulous abscess, a dull yellow appearance is seen, simulating that of a tumour.

These different cases have, therefore, often been confounded together. Indeed, the appearance in question used to be considered so certainly pathognomonic of medullary fungus, that every case in which it presented it self was pronounced to be one of this formidable disease. It having been observed, however, that many such cases being left alone, eventually so far did well, that the disease did not go on to the destruction of the patient, but ended merely in atrophy of the eyeball, surgeons are now agreed that, though suspicious, the yellow appearance at the bottom of the eye does not always indicate medullary fungus.

It must be confessed, however, that there is in general no certain means of determining the nature of the case *à priori*. It is rather by its result that we pronounce on the point.

It may be observed here, that, in some cases, the termination of which in atrophy of the eyeball proved their non-malignant nature, the diseased appearances presented themselves after injury of the eyeball, and were from the first attended by inflammation. In such cases the pupil was of medium size, and as atrophy of the eyeball proceeded, the iris became wrinkled, its middle part sunk in, and its pupillary margin projecting forwards.

Treatment.—For the treatment of the various kinds of growths under consideration, no general rule can be laid down. Often the best practice is not to interfere with them except when external. Atrophy of the eyeball is in general the common and most desirable result of internal growths.

The propriety of excising the eyeball must be determined by the circumstances of the individual case.

9th.—*Scirrhus of the eyeball.*[*]

Under the name of *scirrhus* of the eyeball, some authors describe a disorganised state of it, characterised by its being mis-shapen and indurated, shrunk in size, or if enlarged, but little so, whilst its natural structure is replaced by one having the characters of scirrhus—by its being the seat of burning heat and lancinating pain, and attended by hemicrania in nocturnal paroxysms—by its being slow in its progress, occurring in advanced life, in women rather than men—continuing long without ulceration, and without any implication of the eyelids and neighbouring parts, though eventually ulceration of the eyeball, and implication of the neighbouring parts may take place, and the whole eye thus become the seat of open cancer, the neighbouring lymphatic glands of head and neck being at the same time enlarged, hard, and painful. But such a disease of the eyeball occurring primarily, does not appear to be common. See *Cancer of the eyelids.*

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[*] Hard cancer of the eyeball.

10th.—*Medullary or encephaloid fungus of the eyeball.**

Encephaloid fungus of the eye occurs principally in early childhood, though not exclusively confined to that period of life, and has its origin sometimes within, sometimes outside the eyeball, sometimes in both situations at once.

In encephaloid within the eyeball, three principal stages are recognised. In the *first stage* the eyeball is still of its natural size and general appearance, except that the pupil is more or less dilated, and through it a brilliant reflection from the bottom of the eye is seen. In the *second stage*, the diseased growth, though still confined within the tunics, has advanced towards the anterior part of the eyeball, which has become bloodshot, and more or less enlarged and mis-shapen from distension. In the *third stage*, the tunics have given way, and the tumour protrudes in the form of a fungus.

First stage.—Through the pupil, which is more or less dilated, irregular, and either sluggish or altogether immovable, or moveable only in concert with the pupil of the sound eye, there is seen, under certain lights, a whitish-yellow or reddish-yellow reflection from the bottom of the eye, somewhat resembling that in the eye of the cat. This, on close examination, is perhaps discovered to be owing to the presence of an adventitious substance in the form of a small lobulated tumour, apparently arising from some part of the retina. Red vessels are sometimes seen ramifying on it.

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* Soft cancer.—Fungus hæmatodes.

The vision of the eye may be lost from the first, or it may be still partially retained, objects being seen in certain directions. There is in general no pain, unless there be, as is sometimes, though not generally the case, attendant inflammation, when, as accompaniments of this, there are epiphora, intolerance of light, and headache.

Second stage.—The disease may remain in this state for months, or even two or three years; but, sooner or later, the morbid growth begins to increase, and continues to do so sometimes with such rapidity, that in the course of a few weeks perhaps it will, at the expense of the vitreous humour, have advanced to the front of the eye, pressing the lens and discoloured iris against the cornea. The eye is now more or less inflamed. (Plate IV., fig. 1.)

The advancing growth is seen through the now much-dilated pupil to be more or less distinctly lobulated, and to have bloodvessels ramifying on its surface.

By-and-by the lens becomes opaque. The growth being thus concealed, and the general appearance of the eyeball not being as yet very much changed, cases in this part of their progress have been mistaken for simple cataract, and the operation by division performed. A case was once brought to me in which this mistake had been made.

The eyeball gradually becomes more and more enlarged and mis-shapen from distension by the increasing growth of the tumour, and pervaded by varicose vessels. The cornea is much increased in diameter, vascular, and more or less opaque, and ulcerates; whilst the sclerotica, the boundary between which and the cornea is no longer visible, attenuated and discoloured, bulges out here and there. In this state, the eyeball protrudes from the orbit, and is ready to burst; perhaps the attenuated sclerotica has at some part actually given way, and the tumour, retained by the conjunctiva alone, appears both to the sight and the touch something like an abscess.

The eyelids are distended, swollen, and pervaded by enlarged veins.

Besides pain in the eye, and perhaps intolerance of light, with epiphora, there is pain chiefly in the forehead, vertex, and nape, occurring in paroxysms, which are more severe during the night than during the day.

There is general constitutional disturbance, costiveness, nausea, thirst, loss of appetite, restlessness, fever, delirium.

Third stage.—The cornea giving way, a fetid, bloody, yellowish fluid, together with the lens, if this has not been already absorbed, is discharged, with some alleviation to the sufferings of the patient. The tumour now protrudes in its well-known form of bleeding brain-like fungus. When it bursts through the sclerotica, it may be retained, as above said, for some time, by the conjunctiva; but this at last giving way, it protrudes: severe pain attends this process.

The eyelids are now greatly distended, everted, livid, and pervaded by large tortuous veins.

The lymphatic glands of the cheek and neck enlarge.

The other eye frequently becomes affected, and that even at an early period. Both eyes may be nearly equally affected in the first stage of the disease.

Under the bleeding, sloughing, ulceration, and discharge, of which the fungus is the seat, and the pain and constitutional disturbance, the patient sinks comatose or convulsed.

Medullary fungus has been found originating in almost every structure of the eye.

In some cases, the morbid growth, instead of arising within the eye, and giving rise to the symptoms above detailed, arises from the optic nerve before its entrance into the eye. In this case the tumour pushes the eyeball before it, expanding and enlarging the eyelids, and at last protruding from between them; but, being covered by the conjunctiva, it does not show itself in the form of a fungus until ulceration of that membrane.

The cerebral portion of the optic nerve has been found frequently on dissection to be affected to a greater or less extent. In some cases, also, the brain is itself implicated. As a consequence of the intra-cranial disease, death by coma may occur before the disease of the eyeball has reached the fungus stage.

In the dissection of the bodies of those who have sunk under encephaloid disease of the eye, the same morbid degeneration has, in many cases, been found implicating other organs, such as the testicle, the viscera of the thorax, or abdomen.

Causes.—The scrofulous diathesis, being often presented by those who are the subjects of encephaloid cancer, has been viewed in the light of a predisposing cause, but scrofula is common, and the disease in question rare. It occurs principally in early age, as above said. Mr. Travers has even seen it congenital. Males have been found more frequently the subjects of it than females. As to exciting cause, none has with certainty been detected.

Diagnosis.—The characters above given of encephaloid disease of the eyeball in the early stage, are not perfectly diagnostical of it, for, as already stated, very similar characters, viz., the yellow shining metallic appearance at the bottom of the eye, traversed sometimes by red vessels, may be presented by cases which, as is now known by multiplied experience, are not malignant. The characters even of the second stage have been seen by Dr. Mackenzie, presented in a more or less well-marked manner by non-malignant disease of the eye. In the third stage, the nature of the disease can scarcely be mistaken.

It is to be remarked, that in the early stage of a tumour, whether non-malignant or malignant, springing from the choroid, for example, at the bottom of the eye, there may be a collection of serous fluid between it and the retina, which, besides being folded and undulating, is thereby pushed still further forward in the vitreous than it would have been by the tumour alone. Such a case simulates one of simple detachment of the retina.

Prognosis.—This is in the last degree unfavourable. Neither medicine nor the knife is of any avail in true encephaloid disease.

Treatment.—Cases in which the appearance belonging to the early stage of encephaloid tumour existed, have sometimes turned out so far well, that the eyeball has become atrophic. Long alterative courses of mercury having been used in such cases, it might be said, as Mr. Travers remarks, that they were examples of malignant disease, arrested by this treatment, and not mere examples of non-malignant disease, which would have had the same termination without such treatment.

However this may be, alteratives, the occasional application of leeches, with careful regulation of the bowels, diet, and regimen, constitute the only treatment which experience shows is admissible. Extirpation of the eyeball has been too generally unsuccessful to allow us to hope anything effectual from such a resource. The few cases recorded as recoveries after extirpation, there is every reason to believe were not cases of true encephaloid, but merely of non-malignant disease above noticed (pp. 321, 322), and which would have undergone a spontaneous cure by atrophy whether they had been left to themselves, or subjected to the treatment above mentioned as the only one admissible.

In the advanced stages of the disease, anodynes are required, both internally and externally.

Removal of the diseased mass from the orbit is in some cases advisable, in the hope of relieving the sufferings of the patient occasioned by the distension of the orbit and protrusion of the eyeball.

The following cases afford a good illustration of the progress and pathology of encephaloid disease of the eyeball:—

The patient, a girl about six years old, but very little for her age, was brought to me by Dr. George Birkett. When I first examined the eye, I perceived a whitish-yellow lobulated tumour growing forward from the lower and outer part of the bottom of the eye. (Fig. 62.) Towards the lower part of the prominent surface there was a vascular spot. Pupillary margin of the iris bordered with uvea. The pupil was natural—contracted under the influence of light, and was dilatable by belladonna. The lens unaffected. The diameter of the cornea was somewhat enlarged, and the adjacent sclerotica appeared slightly distended, besides being dark and dirty-looking.

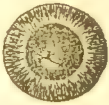

Fig. 62.

Objects below and to the temporal side could be seen, showing that the upper and inner part of the retina was as yet unaffected. No pain.

Otherwise healthy—mother's family consumptive.

Had several falls down stairs, before the disease of the eye was discovered.

Three months after this, my report states:—Of late the eye has become vascular.

Sight appears to be quite extinguished.

About a week ago the general health became suddenly disordered—costiveness, sickness at stomach, and tendency to vomit took place, with thirst and loss of appetite.

The child complains of pain in the orbit and head. Is drowsy—apt to stumble. Strength diminished.

On examination, I found the eyelids red, and somewhat swollen—upper cannot be readily raised. Eyeball rather larger, and more prominent. The pupil somewhat dilated, and immovable by the stimulus of light. The iris of a greenish colour, and its pupillary margin bordered with uvea. The tumour in the interior not much changed, so far as I could determine, the child not permitting a sufficient examination.

Although sight appeared to be extinguished, there was some intolerance of light.

About nine months after the last report, that is about a year after I first saw the child, a fungus protruded at the junction of the sclerotica and cornea, which gradually increased in size. Some bleeding and sloughing from the fungus took place, but not much.

Eight months afterwards the child died convulsed and exhausted.

On dissection, the fungus was found springing from the bottom of the eyeball. The optic nerve was increased in thickness and the seat of the same degeneration, and continuous with a large tumour of the same kind at the base of the brain.

The external tumour was half the size of my fist, and black.

A boy, aged 10, was sent to the hospital by Mr. Philbrick of Colchester, with the following history:—Two years ago, fell from a swing, and injured his eye. The whole anterior chamber was found on examination full of blood, and the sight lost.

About a year and a half after the accident, the boy began to suffer frequently from sudden attacks of pain in the eye and head, accompanied by vomiting. At this time, there was no perceptible difference in the appearance of the eye itself, more than had existed since the accident, except that the vessels of the conjunctiva were injected, and an accumulation of blood and pus was seen in the anterior chamber.

Some time after this, and about six weeks before the boy was brought to the hospital, the eye began to enlarge and protrude from the orbit. Down to the time when I first saw the patient, the protrusion had been going on increasing, with great pain in the orbit and head as well as tenderness in the eye itself—loss of appetite and great depression accompanied this state of things.

In the hope of relieving the sufferings of the patient, I removed the diseased mass from the orbit, but the patient died comatose next day.

The cause of the great protrusion of the eye, was enlargement of the orbital portion of the optic nerve from encephaloid infiltration. The eyeball, though not enlarged, was also affected in the manner disclosed by the following dissection:—

On laying open the sclerotica, there was seen grumous blood between it and the choroid. This being removed, the annulus albidus was observed to be much enlarged, and the seat of an independent development of encephaloid. On dividing the choroid, the shreddy remains of the degenerated retina were seen adhering to it in the situation of the entrance of the optic nerve. No marked continuity between the disease within, and that in the optic nerve outside the eyeball existed. There was no longer any vitreous humour; its place being occupied by the encroachment inwards of the enlarged and diseased annulus albidus.

Anteriorly, the remains of the iris, with lymph blocking up the pupil, were seen.

The cornea was ulcerated through in the middle and the lens gone.

I was indebted to Dr. Charles Drysdale, for the eye of which I next record the dissection. Dr. Richardson of Battersea, who attended the case for a few days before death, and made the post-mortem examination, states that the patient was a child two years old; and that one year since, it was seen by two ophthalmic surgeons in London, who pronounced the disease to be incipient fungus hæmatodes, and wished to remove the eyeball.

Dr. Richardson found the eye prominent, and commencing to separate the eyelids. A bright metallic appearance was observable behind the cornea, and a substance apparently protruding through the dilated pupil. The child was occasionally delirious and convulsed: the bowels obstinately constipated.

Sectio cadaveris forty-eight hours after death.—Dura mater adherent to the calvarium;—encephaloid masses under the arachnoid at intervals; optic nerve of affected eye surrounded by encephaloid enlargement up to the commissure, but all softened and unfit for removal.

The eyeball was of natural size. The structures around it healthy. The cornea was reddish-yellow-looking, from the presence, as was found on dissection, of matter in the anterior chamber, of a puro-lymphy appearance.

Having dissected away the muscles, etc., from around the eyeball, I divided and reflected the sclerotica on one side, thereby exposing the choroid.

Tracing the choroid forwards, I found it, and the ciliary body, whitish and much thickened.

The cornea, which was next cut into from the same side, and a portion of it reflected, was found transparent, but much thinned.

The anterior chamber,—diminished in its antero-posterior depth in consequence of the iris being pressed forward by the morbid formation, to be noticed below, occupying the place of the vitreous body,—contained the reddish puro-lymphy matter above-mentioned. This having been removed, the anterior surface of the iris was exposed.

Through the pupil, which was somewhat dilated, the opaque crystalline projected.

The choroid being next traced backward, was found, in the region of the entrance of the optic nerve, enormously thickened, and of an appearance something like firm white medullary substance which has been hardened in alcohol. This portion of the choroid was intimately incorporated with the sclerotica externally, but internally it was smooth, free, and prominent.

The whole interior of the eyeball, naturally occupied by the retina and vitreous body, was filled with a lobulated mass of encephaloid, here pinkish, there brownish or blackish in tint.

Springing from the place of entrance of the optic nerve, and lying on the inner surface of the much thickened choroid above described, there was a shreddy membranous substance with pigment cells on its surface next the choroid. This, which I considered to be a remains of the retina, was lost anteriorly in the mass of encephaloid, just mentioned as filling the whole interior of the posterior segment of the eyeball.

Under the white and thickened ciliary body, the ciliary zone was found still distinct, but also thickened and deformed.

The iris having been cut through and detached on one side, the posterior chamber was laid open, and found to contain matter similar to that in the anterior chamber.

The opaque crystalline lens with its capsule preserved its natural position in respect to the thickened ciliary zone, but, as above-mentioned, was much pushed towards the cornea by the encephaloid mass behind.

Having completed the preceding examination, I made a longitudinal section of the optic nerve, running into the eyeball. From this it was seen that the sclero-meningeal sheath of the optic nerve was closely adherent by its inner surface to a morbid mass continuous with, and similar to, the thickened and degenerated choroid, with which the sclerotica, as above-mentioned, was in a similar manner intimately incorporated. The proper fibrils of the optic nerve no longer existed, but there were the remains of their neurolemmata, tinged of a bright gamboge yellow colour.

Near its entrance into the eyeball, the optic nerve presented a small nodule on one side, but with this exception was not enlarged, though degenerated in structure as above described.

Examined under the microscope, the encephaloid mass, filling the whole interior of the posterior segment of the eyeball, and encroaching on the anterior segment, was observed to consist of colourless cells in various stages of development, some caudate, about 1-2500th of an inch in diameter, and some pigment cells very much larger, together with a granular matter. There were also traces of a fibrous stroma.

The white and thickened portions of choroid, the ciliary body, and ciliary zone, were composed of similar cells, as was also the reddish puro-lymphy looking matter in the aqueous chambers.

11th.—*Melanosis of the eyeball.*

Melanosis of the eyeball occurs in the middle period of life, more frequently in females than males, and is in general slow in its progress.

It may originate in the conjunctiva or sclerotica, outside the eye, or in some one of the internal structures.

According to the part of the eyeball in which it arises, so do the appearances differ which present themselves at the commencement, and the degree in which vision is impaired. If the morbid growth has its origin in the coats of the eyeball, in the region of the ciliary body, for example, it first makes its appearance shining through the sclerotica, in the form of one large or several small blackish elevations near the margin of the cornea, the white of the eye presenting there enlarged and varicose vessels. The presence of the tumour behind the iris is perhaps indicated by that membrane being, at the corresponding place, pressed forward.

Perhaps there is actual detachment of the circumference of the iris at the place, and the dark mass seen making its appearance from behind. (Plate IV., fig. 3.) In one such case, the lens had become cataractous; in another, it had remained transparent, and vision was still in some degree retained. If the morbid growth arise from the bottom of the eye, there is first seen through the dilated pupil, a slate-coloured brownish tumour, deep in the interior of the eyeball, unless the lens have become opaque. This state is attended with loss of vision. The disease proceeding, the eyeball becomes enlarged, and the black tumour at last presents itself at some part of its surface.

There are now, in consequence of the distension, inflammation and pain in and around the eye; and at last the coats of the eyeball, where the tumour presents, generally the sclerotica near the cornea, give way, and a black fluid is first discharged, followed by the protrusion of a black or brown fungus tumour. This tumour does not in general attain any great size. It seldom bleeds much, though the contrary is sometimes the case; but it may throw off considerable quantities of black matter by sloughing. The proper structure of the eyeball becomes atrophic, being in a great measure replaced by the morbid growth, which may at the same time implicate other structures in the orbit.

Impairment of the general health attends this disease.

Simple sclerotic staphyloma has been sometimes mistaken for melanosis of the eyeball. And, indeed, there is a great resemblance between the two diseases, in the stage of the latter preceding the giving way of the sclerotica and the protrusion of the melanotic substance.

In the following case, there were first presented the symptoms of chronic arthritic ophthalmia, with glaucoma, amaurosis, and cataract,—then those of supervening sclerotic staphyloma, and lastly, the protrusion of a melanotic growth.

A cachectic-looking woman, æt. 63, labouring under prolapsus uteri, ten months before she applied to me, found, on rising one morning, that she had lost the sight of the right eye, having had a severe attack of pain in it during the night. She believed that she saw well with it the day before.

On examination, the white of the eye was seen pervaded by enlarged and tortuous recto-muscular vessels, and of a dark dirty appearance, especially next the inner corner. The pupil was dilated and fixed; the lens glaucomato-cataractous—sight completely gone—not even a perception of light.

A fortnight or three weeks before applying to me, discovered the sight of the left eye to be dim. Since that time she has noticed all manner of coloured light in the dark. She has also suffered very severely from circum-orbital pain on this left side as well as on the right.

The recto-muscular vessels of the left eye were seen on examination to be slightly enlarged and tortuous; the pupil natural, and the lens glaucomatous, and slightly cataractous.

By treatment the sight of the left eye became somewhat more distinct, and the pain around it relieved. But the pain around the right eye continued very severe, preventing sleep, so that it was necessary to give anodynes.

The patient went on in this manner for some months, when a dark coloured projection like a common sclerotic staphyloma presented itself at the inner and upper part of the eyeball, along with an aggravation of the pain. At this time, I advised the excision of the eye, but the patient would not submit to the operation. After this, the pain, however, appears to have subsided; and I saw nothing more of the woman for about nine months, when she applied again to me on account of the very excruciating pain she had been suffering for some days. On examination, I found the eyeball much larger than when I saw it last, and that in the situation of the staphylomatous-like projection before mentioned, the sclerotic had just given way, and melanotic matter was protruding through the opening. The cornea, through which could still be seen the dilated pupil and glaucomato-cataractous lens, was turned downwards and outwards by the projection of the upper and inner part of the eyeball.

Prognosis and treatment.—The prognosis in melanosis of the eyeball is but little more favourable than in the encephaloid disease. After extirpation of the eyeball, patients have survived longer, though in most cases they have eventually sunk under cancerous affections of the viscera.*

12th.—*Operation of extirpation of the eyeball, and its surrounding parts.*

Position of the patient, assistants, and operator.—The patient is to be extended on his back on a table, with his head raised by a pillow. He is then to be brought under the influence of chloroform. One assistant steadies the head and takes charge of the upper eyelid; the other assistant, standing on one side of the table, takes charge of the lower eyelid, whilst the operator stands on the other side of the table—the side, namely, corresponding to that side of the patient on which the operation is to be performed.

The following directions for extirpating the eye must be understood to be of a general character, such merely as are principally indicated by the anatomy of the parts. The disease for which the operation is undertaken may have occasioned such a condition of parts as to require some considerable modification in the procedure; but this must be determined by the judgment of the operator at the time. The operation comprehends the following steps:—

First, or preparatory steps.—For the purpose of holding and moving about the eyeball during the operation, it is thrust through with a tenaculum, or a strong ligature is passed through it from the one side to the other, by means of a large curved needle, the ends of the string being then tied together, so as to form a loop to hold by. If the eyeball is much enlarged and protruding, it may be simply grasped with the hand, having been first wrapped round with a bit of lint.

Division of the external commissure of the eyelids.—This facilitates the operation, and obviates the risk of cutting the edges of the eyelids. Whilst the eyelids are held much asunder, and the external commissure is well drawn towards the temple, the operator pushes the sharp-pointed bistoury, its back next the eye, between the commissure and the margin of the orbit, and onwards under the skin for the extent of half an inch or more towards the temple.

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* Melanosis in the orbit, and of the conjunctiva and eyelids, is considered below under those headings.

when the point is made to transfix the skin. By now pushing the knife on, it cuts itself out, and the division of the commissure is accomplished.

Second steps, comprising the extirpation.—Whilst the assistants keep the eyelids much drawn asunder, the surgeon, holding the scalpel in one hand, with the other rolls the eyeball upwards, in order to expose fully the lower conjunctival fold. This he freely divides from one angle to the other by plunging the scalpel into the orbit at one angle, and carrying it along the margin of the orbit with a sawing motion to the other angle.

Having withdrawn the scalpel, the surgeon next rolls the eyeball downwards, and cuts in the same way through the upper conjunctival fold, carrying the knife along the upper margin of the orbit from one angle to the other.

The incisions are now made to join each other at the angles, and by rolling the eyeball first to the one side, then to the other, what tags still exist are to be divided.

If the ocular conjunctiva be still sound it ought to be preserved. In order to this, it is first of all to be detached from the margin of the cornea all round as in the operation of excision (p. 287), then slit up towards the canthi, and lastly dissected from off the eyeball towards the eyelids. After this reflection of the conjunctiva, the incisions into the orbit round the eyeball are to be made.

The optic nerve, with the recti muscles, is next to be divided. For this purpose the curved scissors are introduced into the orbit along, and with their convexity towards, the upper and inner wall, whilst the eyeball is kept rolled downwards and outwards. Being now opened, they are pushed on so as to include between their blades the optic nerve, surrounded by the muscles close to the optic foramen, when these parts are to be cut through. After this the eyeball is readily drawn forth of the orbit, the scissors being used to divide any remaining tags.

The orbit is now to be explored with the finger, and if any suspicious structure be discovered, it is to be removed. If the lacrymal gland be at all indurated and enlarged, it ought to be seized with a hook, dragged from its fossa, and, along with its surrounding cellular tissue, removed with the scissors.

Dressing.—The bleeding usually abates of itself, or on the application of cold water; if not, pressure with a plug of lint is to be made. The orbit is now to be lightly filled with charpie, the divided external commissure united by a stitch or two, and the whole covered with a piece of spread linen with holes cut in it, and a light compress and roller.

If the eyelids are so involved in the disease of the eyeball as to require to be extirpated also, an incision is to be made through the sound skin all round the margin of the orbit, and the eyelids detached therefrom, and reflected towards the eyeball. The eyeball, including the eyelids, is then to be secured with either the tenaculum or ligature, and the extirpation proceeded with as above. In this case it will be observed that there is no cutting of the conjunctival folds, all the conjunctiva being removed along with the eyelids and the eyeball.

After treatment and healing of wound.—Although extirpation of the eyeball is a severe, and without chloroform a very painful operation, it is in general not attended by any considerable accident, even in weakly patients; and recovery in general readily takes place under the treatment usual after great operations. But unfortunately the disease, on account of which the operation is most commonly undertaken, is very apt to break out again in the adjoining or some other parts. In this point of view, extirpation of the eyeball is very far from being a successful operation. Indeed, in many of the cases in which it used to be had recourse to, viz., medullary fungus and cancer, it is now generally refrained from. And as to the other cases, it is rare that there is any necessity for it; enucleation or simple excision (p. 286) being almost always sufficient, except when the disease of the eyeball is complicated with a tumour in the orbit. See below, *Orbital tumours.*

Inflammation must be met actively, as it is apt to extend to the membranes of the brain and prove fatal. When the charpie has become loosened by the occurrence of suppuration, it is to be removed, and the orbit washed gently out with tepid water and again lightly filled with charpie. As granulation goes on, less and less charpie is to be introduced at the subsequent dressings.

SECTION II.—CATARACT.

Cataract is manifested by a greyness or whiteness in the pupil, which is naturally of a clear black, and consists in a greater or less opacity of the crystalline body, whereby the rays of light are, in a proportionate degree, intercepted on their way to the retina. The consequence is, that vision is impaired or reduced to a mere perception of light and shade.

GENERA AND CAUSES OF CATARACT.

The opacity may be seated in the lens itself, or in its capsule, or in both lens and capsule at the same time. Different kinds of cataract are accordingly recognised, viz., *lenticular*, *capsular*, and *capsulo-lenticular*.

The distinction of these different kinds of cataract is a point of no small importance, for on it depends a correct conception of the rise and progress of the disease, and, especially, the discrimination of the operative procedure best adapted to effect a restoration of vision in a given case.

Cataract, as above defined, is sometimes distinguished by the epithet *true*, in contradistinction to what has been called *false cataract*, which consists in opaque deposits of lymph, pus, blood, &c., on the anterior capsule,—the consequence commonly of anterior internal inflammation of the eye. False, however, may be combined with true cataract, lenticular, anterior capsular, or capsulo-lenticular.

Relative frequency of Cataract at different periods of life.—Of 3467 cataract patients (1691 males, 1568 females; sex of the remainder not mentioned) the ages were as follows: —*

From 1 to 10 years	208
,, 10 20 ,,	225
,, 20 30 ,,	263
,, 30 40 ,,	262
,, 40 50 ,,	358
,, 50 60 ,,	627
,, 60 70 ,,	922
,, 70 80 ,,	545
,, 80 and upwards	57
	3467

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* Statistics of Cataract, R. L. O. H., by Mr. Streatfeild, in Ophthalmic Hospital Reports. London, 1857.

Causes.—Cataract sometimes occurs already at birth, and, like ill-formed teeth, may be viewed as an example of imperfect development. In advanced life, again, cataract is so common, that it may be looked upon as, in some degree, a natural degeneration of structure, analogous to the decay of the teeth or whitening of the hair.

Congenital cataract is sometimes met with in several children of the same family—a circumstance which points to some peculiarity in the health of the parents. The children of parents who are first cousins are often the subjects of congenital defects—amongst others, congenital cataract.

The cataract which occurs in advanced life cannot, in general, be attributed to any particular exciting cause, as it is met with in all conditions of life, and under the most varied circumstances. An hereditary predisposition, however, often appears to exist.

Cataract arising in youth and manhood can often not be traced to any particular cause. Sometimes it is owing to inflammatory degeneration of the eye; sometimes it it is the result of injury. Diabetes is here also to be named as a cause.

Traumatic cataract.—We have above seen (p. 129) that wound of the capsule leads to opacity of the lens. The capsule may be wounded by a penetrating instrument, or burst by a blow. Opacity, however, may take place independently of any such wound, in consequence of disruption of the connection between the capsule and ciliary zone from a blow.* In this case, the lens, at the same time that it becomes opaque, acquires a globular form (*cataracta cystica*); and if the connection be only partially broken, flaps backwards and forwards in the vitreous humour, which has become dissolved (*cataracta cystica tremulans*); but when its detachment from the ciliary zone is complete, it falls down below the pupil, and swimming about (*cataracta cystica natatalis*), is liable to pass through it into the anterior chamber. Such a cataract is almost always complicated with amaurosis.

Diabetic cataract.—Persons labouring under diabetes are liable to impairment or loss of sight. This is owing either to amblyopia or lenticular cataract, or both. Diabetic amblyopia, which is of more frequent occurrence than diabetic cataract, is owing to implication of the optic nerve in the attending cerebral affection. Under the ophthalmoscope the papilla is seen white (pp. 54—128).

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* See *infra*, on injuries of the crystalline body.

Diabetic cataract occurs in an advanced stage of the general disease, and is usually soft and large, but presents no peculiar anatomical characters. That the opacity is induced by the direct action of the sugar, pervading the system, on the lens, would appear from the fact, that a frog may be rendered cataractous by placing it in sugared water.

I.—LENTICULAR CATARACT.

This constitutes the typical example of cataract; and whilst it is the most common kind, it is fortunately that which admits of being most successfully treated.

There are certain appearances which lenticular cataract may present, dependent simply on the natural structure of the lens, rendered visible by its having become opaque, and which may therefore be studied in a healthy lens, removed from the eye after death, and rendered opaque by reagents. These appearances deserve to be noted before proceeding to inquire into the objective characters of the different species of lenticular cataract.

1st. *The glistening appearance like tendon, or mother-of-pearl.*—This is owing, as in the case of tendon, or mother-of-pearl, to the mode in which the light is reflected by the peculiar surface of the opaque fibrous structure.

2nd. The appearance of a star with three radii, extending from the centre towards the circumference of the lens, one upwards and a little outwards, one downwards and inwards, the third downwards and outwards, less opaque than the rest of the lens, and without the glistering appearance. This is owing to a substance, different from that of the rest of the lens, intervening between the anterior ends of the fibres, thus :—Fig. 62.

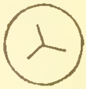

Fig. 63.

This substance becoming distended, by the imbibition of fluid apparently, the stellate appearance is rendered more evident, thus :—Fig. 63.

Species of lenticular cataract.—The character by which it is of most importance to distinguish species of lenticular cataract, is consistence; for this has reference to the kind of operation to be undertaken for their cure. According to their consistence,

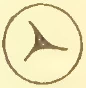

Fig. 64.

lenticular cataracts are divided into *hard*, *soft*, and *fluid*.

Diagnosis of consistence.—Generally speaking, hard cataracts are met with in persons advanced in life, have a colour which is a mixture of gray and amber, and are of a size not exceeding that of the healthy lens. Soft cataracts, on the contrary, occur in young persons, have a gray or milk-and-water colour, and are of a size at least equal to, but often exceeding, the natural size of the healthy lens. Fluid cataracts are characterised by their whiteness or whitish-yellow tint and prominence, especially at the most depending part.

Diagnosis between lenticular and capsular cataract, and between lenticular and capsulo-lenticular cataract.—The opacity of lenticular cataract is of some tint of gray, and if streaked, uniformly so, from centre to circumference; in capsular cataract, on the contrary, the opacity is white and irregularly streaked or speckled; whilst in capsulo-lenticular cataract, the opacity is a variable combination of lenticular and capsular opacity, as will be more particularly detailed under the head of capsulo-lenticular cataract.

1st.—*Hard or common lenticular cataract of old people.*

Between fifty and eighty is the age of the majority of persons who present themselves with this form of cataract. There are few younger than fifty, because the complaint is of rare occurrence below that age. There are also comparatively few older than eighty, not, however, because the disease is of less frequency above that age, for the contrary is the case, but because there are then fewer people living.

The *consistence* of the lens is greater than natural, especially as regards the nucleus. The *size*, not greater. The *colour*, a mixture of gray and amber—the amber colour predominating in the middle, where the opacity appears greatest. The cause of this peculiarity of coloration is, that the central nucleus of the lens is the seat of the amber colour, and this sometimes without any actual opacity, whilst the superficial part of the lens is the seat of the gray opacity. Sometimes, there is nuclear with little superficial opacity; sometimes superficial, with little nuclear. Generally, the nuclear appears first, and the superficial is gradually superadded.

The superficial gray opacity, which may have more or less of the glistening appearance on the surface above described (p. 339), sometimes presents itself in the form of streaks, *converging* from the circumference of the lens, where they are broad, towards the centre, where they become narrow. These streaks are fasciculi of fibres more opaque than the rest. When the posterior superficial strata are thus affected, the opacity appears deep-seated and concave.

In some cases we can observe this opacity of the superficial strata, both anterior and posterior, together with nuclear opacity, whilst the intermediate part of the lens is still pretty clear.

Lenticular cataracts occur, in which, while the central nucleus is as hard as in hard cataracts, just described, the peripheral strata are softer—softer even than in the healthy state of the lens. They also belong to advanced life, and indeed appear to be an advanced stage of the preceding form. The peripheral strata of the lens, at the same time that they are softer, are more opaque. In consequence of this, the brown-yellow or amber colour of the hard central part of the lens is not seen, or but indistinctly; the general colour of the cataract being that of the more opaque superficial strata, *viz.*, whitish-gray.

Sometimes hard cataracts are of a dark brown colour, like mahogany; such are called *black cataracts*.

Subjective symptoms.—When the cataract is pretty fully formed, everything right before the patient generally appears to him as if obscured by a thick cloud or gauze, but objects placed to one side, or above or below, he may still perceive less indistinctly. In bright light, vision is still more indistinct; in moderate dull light it is less so. The opposite of all this, however, sometimes occurs, *viz.*, that the patient sees right before him better than to one side, and in a strong as well as in a dull light—sometimes better. Lastly, objects may not be seen at all, but vision may be reduced to a mere perception of light and shade.

The peculiarities in the state of vision now enumerated, present themselves according as the opacity is greater or less in the centre than at the circumference of the lens, or as it is equally great in the centre and at the circumference.

In the first and more common case, *i. e.*, when the opacity is greater in the centre than at the circumference of the lens, the rays of light from objects right in front of the eye are less freely admitted or are altogether intercepted by the more opaque central part of the lens; whilst the rays of light from objects situated to one side are more freely admitted through its less opaque circumferential part. In bright light, the pupil being contracted, the less opaque circumferential part of the lens is covered, and only the more opaque central part presented to the rays of light, so that even the vision of objects placed sideways is interrupted; whereas in dull light, the pupil being dilated, the less opaque circumferential part of the lens is, to a considerable degree, uncovered, and more free entrance of light thus permitted. When the pupil is under the influence of belladonna, vision is still more decidedly improved, as the dilatation produced by belladonna is greater than that which takes place in dull light.

In the second and rarer case, *i. e.*, when the opacity is less in the centre than at the circumference, the rays of light from objects right in front of the eye are more freely admitted by the less opaque central part; whilst the rays of light from objects to one side are less freely admitted, or are altogether intercepted by the more opaque circumferential part of the lens. In bright light, though the pupil is contracted, the less opaque central part of the lens is still uncovered for the passage of the rays of light, and hence vision is uninfluenced.

When the opacity involves equally the central and circumferential part of the lens, vision is nearly equally defective, whether during a dilated or a contracted state of the pupil.

Objects, when they are still to be perceived, sometimes appear to the cataractous patient distorted and multiplied.

Objective symptoms.—The general bearing of the cataractous patient, the expression of his features, and the movements of the eyeball, have been above noticed (p. 2). By keeping his head bent forwards, his eyebrows knit and depressed, his eyelids half closed, and by looking at objects sideways, he appears as if intolerant of light. He does, indeed, by these means, seek to shade the eyes, but not because he cannot bear the light, but because he in general finds that when his eyes are shaded he sees better.

As regards the appearance of the eye:—The clear black of the pupil is wanting, and in its stead there is an opaque appearance, presenting in various degrees of intensity, combination, and extent, the characters above described (pp. 340, 341). On examining carefully the opaque appearance, especially by looking into the eye sideways, it is seen in the situation of the crystalline body. On making a catoptrical examination of the eye (p. 34), it is found that the posterior erect and the inverted images are not produced, if the anterior part of the crystalline body be opaque, whether the rest be opaque or not; but if it is the centre or the posterior part only which is opaque, the posterior erect image is produced, but not the inverted one. The inverted image, however, does not always disappear, though there is opacity of the anterior layers of the lens, sufficient to prevent the formation of the deep erect image. When the opacity is as yet slight. the images may be produced, but will be more or less indistinct. Of course the anterior erect or corneal image is not affected, unless the cornea is diseased.

In assisting the differential diagnosis of amaurosis and incipient cataract, and perhaps, in rare cases, of black cataract, the catoptrical test was of considerable use, but it has now been superseded by the ophthalmoscope.

That the opacity is seated in the lens may generally be determined by a practised surgeon without dilating the pupil by belladonna, but of course no formal opinion should be pronounced by beginners of the exact nature of the case until an examination has been made whilst the pupil is under the influence of belladonna.

The pupil being dilated, oblique illumination enables us to ascertain the state of the crystalline lens very completely.

The various aspects under which anterior capsular cataract presents itself,—the streaks of opacity in the anterior cortical substance of the lens converging from the circumference, where they are broad, towards the centre, where they become narrow,—the concavity of the opaque surface when the deep cortical strata are alone or principally cataractous,—the amber-coloured nucleus shining through the greyish opaque cortical substance of the lens in the ordinary cataract of old people, are all distinctly seen.

It has been above stated that for all practical purposes, opacity of the lens can be sufficiently well ascertained by ordinary exploration, by oblique illumination, with the pupil dilated. By means of the ophthalmoscope, adjusted for the purpose, however, otherwise undistinguishable opaque points or streaks can be seen.

By means of the ophthalmoscope, moreover, we can assure ourselves of the transparency of the lens, which we cannot always otherwise do.

Viewed by oblique illumination, opacities of the lens appear of their natural white, grey, or dull amber tint. Viewed under the ophthalmoscope, they appear blackish, whilst the redness of the fundus is seen through any clear spaces that may still exist between them.

The uvea at the extreme pupillary margin of the iris is in cataract brought by contrast more distinctly into view than usual, and looks like a dark ring encircling the pupil.

The form and motions of the pupil are natural, unless the cataract be so large as to press upon the iris, which, however, is not usually the case in hard cataract, or unless the case be complicated with morbid adhesions, amaurosis, &c.

Rise and progress.—The dimness of vision and objective opacity, in general, begin in a very unmarked manner, and increase slowly for perhaps months or years, until they have attained the degree above described. Usually one eye is affected first, and by-and-by the other. In rarer cases both eyes become affected at the same time.

Nature of the change in the lens.—Lenticular cataract consists in a marasmus and opacity of the proper substance of the lens. When examined under the microscope, the fibres are seen to be shrivelled and dry-looking, and instead of a homogeneous interfibrous substance, there is a molecular matter, consisting of fatty granules, myeline globules, &c. As glass becomes opaque on being powdered, so does the lens when its substance is thus resolved into heterogeneous particles irregularly mixed.

Differential diagnosis.—Glaucoma with amaurosis is the disease with which the lenticular cataract of old people is most likely to be confounded. It is, however, to be observed, that a case of this form of cataract, even in its incipient stage, is less likely to be mistaken for a case of glaucoma with amaurosis, than a case of glaucoma with amaurosis is for one of cataract. The following diagnostical table displays the principal points of difference between cataract on the one hand, and glaucoma with amaurosis on the other.

Objective symptoms.

CATARACT.	GLAUCOMA WITH AMAUROSIS.
The eyeball presents to the touch the natural degree of firmness.	The eyeball is preternaturally hard to the touch.
The opacity is readily recognised to be well-defined, and distinctly seated in the lens, and not to change its place with the direction of the light. When the pupil is dilated by belladonna, the cataract is still more distinctly and extensively seen.	The opacity appears deep-seated, but where it is seated one cannot, by merely looking into the eye, say exactly, especially as it changes place according to the direction in which light is admitted to the eye, appearing always on the opposite side. It is not seen more distinctly when the pupil is dilated.
The pupil in its movements always quite natural. Dilates under the influence of belladonna, quickly and uniformly.	The pupil is more or less dilated, and if not quite immovable, its movements are limited and slow. Yields slowly and irregularly to the influence of belladonna, if not already quite dilated.
Even in an early stage, the inverted image is obscure or obliterated, and the deep erect one very indistinct.	Glaucoma only when much advanced, obliterates the inverted image, while in all its stages, it renders the deep erect one more evident than it is in the healthy eye.
The inverted image, long before the cataract is fully formed, is not produced, or but indistinctly, whether the candle be held opposite the central or the circumferential part of the lens, owing to the circumstance, that it is the superficial strata of the lens which are first affected, and which of course prevent the distinct formation of the inverted image, as well by the middle as by	In glaucoma at a middle stage, the inverted image is pretty distinct when formed near the edge of the crystalline; but if the candle be brought in front of the eye, the inverted image is less distinct, and in some cases is altogether extinguished. This extinction of the inverted image, when the candle is brought in front of the eye and not otherwise, is owing to a loss of tran-

CATARACT.	GLAUCOMA WITH AMAUROSIS.
the circumferential part of the lens.	sparency in the kernel of the lens, while the superficial strata are still transparent.
The bottom of the eye cannot be seen under the ophthalmoscope, unless the cataract be partial. In this case the opacities of the lens appear blackish, and the redness of the fundus is seen through the clear intervening spaces (p. 344).	The bottom of the eye and its peculiar alterations may be seen and examined under the ophthalmoscope (p. 54, and also infra).
Subjective symptoms.	
Vision in general diminishes slowly; in rare cases, however, quickly. No photopsy, but muscæ volitantes sometimes very evident.	Diminution of vision often sudden; sometimes, however, slow and gradual. Fiery and coloured spectra before the eyes, are of common occurrence.
In general quite unattended by any constitutional disturbance. No internal inflammation nor pain.	Generally accompanied by constitutional derangement. Often symptoms of internal congestion, or actual posterior internal inflammation with supraorbital or temporal pain.
Objects situated sideways more distinctly seen in general; inwards, outwards, upwards, downwards, indifferently.	Objects situated to some *one* side, not any side indifferently, often more distinctly seen, as some *one* part of the retina may be less affected than the rest—inside or outside only, above only, or below only.
Vision better in dull light. The opposite of this occurs, but rarely, when the circumference of the lens is more opaque.	Vision worse in dull light. The opposite of this, however, sometimes occurs in the erethitic form.
The flame of a candle or lamp appears expanded and	The flame of a candle or lamp appears lost, but its

CATARACT.	GLAUCOMA WITH AMAUROSIS.
diffused, as it is seen when we look at it through obscured glass.	place surrounded by spreading rays.
In general, the vision is not liable to be better some days, worse others.	Often vision is better one day, worse another.
Diminution of vision is in proportion to the opacity of the lens.	Diminution of vision much greater than the *appearance* of opacity of the lens would account for.
Perception of light at least never lost, even when the opacity is very dense.	All perception of light may be lost, and yet the appearance of opacity may not be much greater. Complete cataractous opacity may, however, supervene.

Prognosis and treatment.—When once begun to form, it may be prognosticated that the opacity will go on to increase until all useful vision is prevented in the eye. And it may also be prognosticated, that the other eye, if not already, will likewise become affected. How quick or how slow the progress to loss of useful vision may be, cannot be prognosticated—it may be months, or it may be years. It may be said that hard nuclear cataract advances more slowly than soft cortical cataract, and that in the latter the progress is slower when the opaque streaks are fine than when they are broad.

Restoration of vision can be effected only by an operation, by which the opaque lens shall be extracted from the eye altogether (*the operation of extraction*), or, in some cases, divided and removed by absorption (*the operation of division*), or removed from its situation to below the level of the pupil (*the operation of displacement*).

2nd.—*Soft or common lenticular cataract of young people.*

This cataract is of the same consistence as that which is natural to the lens, or softer, and of a grayish-white or milk-and-water opacity. The superficial strata of the lens are commonly the first affected. It presents, in the earlier stages of its opacity, the glistening tendinous aspect and stellate appearance above described; in short, the soft cataractous lens at first very closely resembles a healthy lens, rendered opaque and swollen by the action of reagents. But by-and-by it comes to have less of the appearance of the original structure, the fibres being broken up and resolved into a grayish molecular pappy substance, containing fatty granules and myeline globules.

In a more advanced stage, the liquid part of this pappy mass may pass out by diffusion through the walls of the capsule, and what remains will form a thin opaque greyish-yellow cake, of small diameter (*discoid cataract*). Indeed, it sometimes becomes so much shrunk in diameter, that when the pupil is dilated, the *zonula lucida* appears around it, and radiating white bands are seen extending from it to the ciliary body (*cataracta cum zonula*). It is also so much shrunk in thickness, that it is evidently at a considerable distance behind the iris, which may in consequence be inclined backwards. It admits of being easily broken up.

In the lenticular cataract of young people, the nucleus only is sometimes found opaque, while the cortical part is as yet quite transparent.

Subjective symptoms.—Vision is diminished in proportion to the opacity, in a manner analogous to what is above described to be the case in hard cataract.

Objective symptoms.—These are, on the whole, much the same as those of hard cataract above described, with the exception of such differences as are produced by the differences in colour, general aspect of the opacity, and size of the cataractous lens.

The iris and pupil may be natural, but according to the size of the lens, so will be its closeness to the iris. If, as is often the case, it is so large as to press on the iris, the motions of the pupil are impeded.

Causes.—The occurrence of opacity of the lens in young persons is very much rarer than in old persons. It is often met with as the result of injury. In children affected with lenticular cataract, we are sometimes told that the opacity made its appearance after convulsions. In adults, we have seen, it sometimes supervenes in diabetes. In other cases it cannot be traced to any cause.

Diagnosis.—There is no likelihood of this form of lenticular cataract being confounded with glaucoma, as the latter disease does not occur except in old persons. It is to be remembered, however, that this form of cataract is not unfrequently complicated with amaurosis. Soft lenticular cataract, being whiter than hard, is less readily distinguished from capsular cataract.

In the advanced stage above described, under the name of *discoid*, there is a resemblance to *siliquose* capsular cataract.

Prognosis and treatment.—What is above said on these heads (p. 347), in regard to hard cataract, is in general applicable here, except that soft cataract is more rapid in its progress than hard, and that the kind of operation best adapted for the removal of the opaque lens, is that by *division*, in order to its solution and absorption, or extraction through a puncture-section of the cornea.

3rd.—*Fluid cataract.*

In fluid cataract, the capsule may be seen, when the pupil is dilated, bulged forwards at the lowest part by the subsidence of the opaque fluid. In this state, the opacity is, as above mentioned, greater below than above.

The milky white or yellowish fluid is composed of the cortical substance of the lens resolved into a state of emulsion, with fatty granules, &c.

What has been called Morgagnian cataract appears to be an early stage of fluid cataract, and to consist in softening and opacity of the exterior part of the lens, with perhaps absorption by endosmose of aqueous humour into the capsule, determined by the diseased state of the lens, similar to what takes place after death, and which is the true source of what is called the Morgagnian fluid.

II.—CAPSULAR CATARACT.

The anterior and posterior walls of the capsule may be separately affected with opacity. Hence are recognised anterior capsular cataract, and posterior capsular cataract. Opacity of the lens is apt to supervene, so that the case merges into capsulo-lenticular cataract.

1st.—*Anterior capsular cataract.*

The opacity in anterior capsular cataract has more analogy with opacity of the cornea than opacity of the lens, being owing to opaque deposit on the outer or inner surface of the capsule. It is usually dead white, and either implicates the whole anterior wall of the capsule, or perhaps one half, or occurs in abruptly-defined patches, spots, or streaks, quite irregular both in form and disposition, except in the case of *central capsular cataract*, in which the opacity occurs in the form of a single elevated opaque spot, seated in the centre of the capsule. This elevated opaque spot is sometimes of a pyramidal shape, its apex projecting towards the pupil.

According to the differences in the general aspect of anterior capsular cataract, produced by the differences in the disposition of the opacities, such names as the following have been given to the cataract:—*cataracta capsularis anterior totalis*, *dimidiata*, *centralis*, *punctata*, *marmoracea*, *striata*, *&c.*

Motions of the pupil.—The motions of the pupil may be natural, but very often they are impeded by adhesions between the pupillary margin of the iris and the capsule of the lens.

Subjective symptoms.—According to the situation and extent of the specks, so the loss of sight may be greater or less than in lenticular cataract. Complications often exist which may interfere with vision more than the mere capsular opacity.

Causes.—Anterior capsular cataract appears generally to be the result of inflammation of the eye,—ophthalmia neonatorum, or scrofulous ophthalmia, for example, more frequently than of iritis. Often it is congenital.

The *diagnosis* of anterior capsular cataract is founded principally on the superficial seat and whiteness of the opacity, and its speckled disposition.

Prognosis and treatment.—Anterior capsular cataract is like opacity of the cornea, not prone to extend, the inflammation which originally gave rise to it having ceased: and it may continue for many years, or for life, without the supervention of lenticular opacity. Not unfrequently so much vision is still preserved that no interference in the way of operation is required. Any operation that may be undertaken, must be the same as for capsulo-lenticular cataract, for the capsule cannot be removed without sacrificing the lens.

2nd.—*Posterior capsular cataract.*

Of simple uncombined opacity of the posterior wall of the capsule little is known. Opacity of the posterior strata of the lens (p. 341), has been sometimes mistaken for it.

III.—CAPSULO-LENTICULAR CATARACT.

In capsulo-lenticular cataract, the opacity may be partial or complete. It may be confined to a small spot on the middle of the anterior capsule, and of the lens, the rest of the body being healthy; or the opacity may be to a greater extent, and the lens hard, soft, or in a more or less fluid state. The opacity of the anterior capsule, which varies in degree as in simple anterior capsular cataract, may be combined with thickening of it.

Sensibility to light is occasionally very feeble in capsulo-lenticular cataract, owing in some cases to the density of the opacity, in others to the presence of amaurosis. Cataract supervening to amaurosis, and especially to traumatic amaurosis, is frequently capsulo-lenticular. The cataract is slow in its progress under such circumstances. At length the vitreous humour dissolves, and the iris and cataract become tremulous.

According to the differences above enumerated, different species of capsulo-lenticular cataract are recognised.

1st.—*Central capsulo-lenticular cataract.*

This seems to belong to the same head as central capsular cataract, from which it differs merely in presenting a circumscribed opacity of the lens at the place corresponding to the opacity of the capsule. Both species occur congenitally, or make their appearance shortly after birth—often after ophthalmia neonatorum. The lenticular opacity may be broader, but is not in general so dense as the capsular. Central cataract is rarely capsular merely, but is in general capsulo-lenticular. It often co-exists with congenital defects. I have met with it along with night blindness.

The effect of central capsulo-lenticular cataract on vision is short-sightedness.

Prognosis and treatment.—No operation is called for. If the pupil is not habitually dilated so as to expose the clear part of the crystalline for the passage of light, the drops of belladonna or atropia are to be used for that purpose (p. 83). In such cases the operation of dislocation of the pupil to opposite a clear part of the lens has been performed and recommended by Mr. Critchett. See below. The lenticular opacity is apt eventually to extend, so that the removal of the cataract by an operation becomes necessary.

2nd.—*Common capsulo-lenticular cataract.*

The appearances are those principally of anterior capsular cataract, when the opacity of the anterior capsule is complete. When the opacity is incomplete, the opacity of the lens is seen through the transparent places. The lens may be hard, soft, or fluid.

Such a cataract is almost always complicated with a morbid state of the posterior segment of the eyeball, and amaurosis.

3rd.—*Siliquose cataract.*

This results from the more or less complete absorption of the lens, by a process of osmose or diffusion, with collapse, thickening, and opacity of the capsule. It is white, firm, and tough, and evidently has its seat at a considerable depth in the eye.

PALLIATIVE TREATMENT OF CATARACT. CAN CATARACT BE CURED WITHOUT AN OPERATION?

In many cases cataractous patients have their sight temporarily improved by dilating the pupil with belladonna or atropia. Some, however, are dazzled by this. And in some, though benefit is obtained, congestion of the eye is induced, so that it is necessary to discontinue its further employment (p. 143).

There have been, and there are at the present time, persons who pretend to cure cataract without an operation; and witnesses to their skill are not wanting, either in persons who allege to have been themselves thus cured of cataract, or in persons who aver that they are acquainted with those who have been thus happily restored to sight.

On the other hand, all medical men of reputation and experience in the treatment of the diseases of the eye, affirm that they have never known a case in which true cataract, when once formed, has been cured without operation, that is, in which the lens, having once become opaque, has been again rendered transparent, or at least been removed, either by the efforts of nature or by any kind of medical treatment.

In corroboration of this, I have to add my testimony, and at the same time declare my belief, that the allegations that cataract has been cured without an operation are some of them false, whilst others are founded on ignorance and mistake as to the nature of the cases treated as cataract.

Persons, by applying belladonna to the really cataractous eye and thereby dilating the pupil, have improved the sight for a time, and have called this *curing* cataract without an operation.

An artifice, alleged to have been adopted, has been to puncture the eye and lacerate the capsule with a fine needle without the patient's knowledge, and to continue various applications, whilst all the time the cataract was disappearing by absorption in consequence of the operation of division thus clandestinely performed.

Again, specks of the cornea have been called cataract, and as these frequently admit of being removed by treatment, the case has been put down as cataract cured.

Lymph in the pupil from iritis is known under the name of false cataract. Being removed by absorption, as it sometimes is, and the sight improved, this also has been put down as cataract cured without operation.

There are cases, again, in which the lens may be really somewhat opaque or cataractous, though not sufficiently so to interfere very materially with the sight, but in which, from congestion of the eye, the sight has become impaired. Now, treatment in such cases often has the effect of removing the congestion, and thereby improving the sight. This is then held up as an indubitable case of cataract cured without an operation, whereas the cataractous opacity of the lens remains undiminished and will go on to increase as usual, and eventually obscure the sight in spite of all treatment.

There are other cases, again, in which there is an appearance of dimness of the lens, but not true cataractous dimness, though it is liable to be mistaken for such by practitioners not much conversant with diseases of the eye. Along with this dimness in the pupil there is impaired sight, not from opacity of the lens but from impaired sensibility of the retina. The sight in such cases being sometimes capable of more or less temporary improvement by treatment, such as counter-irritation, this improvement is held up as an example of the cure of cataract without operation. In such cases, however, sight eventually becomes more and more impaired, or actually lost.

By a blow on the eye, the capsule of the lens is sometimes burst. The immediate effect of this is cataract, but gradually, by the solvent action of the aqueous humour, the opaque lens is dissolved, and eventually removed by absorption. The cataract is in this manner cured by the efforts of nature, not, however, without an operation, for the injury causing the capsule to burst was an operation—the same as that which is called the operation by division. In short, the injury was at once both bane and antidote.

It is thus evident that there is full scope for imposition in respect to the curability of cataract without operation, especially as there are so many people ready and willing to believe in it, and to believe even still more unfounded pretensions.

THE OPERATIONS FOR CATARACT.

The restoration of vision in fully formed cataract cannot be effected by any means short of operation. The different operations for this purpose have for their common object the removal of the opaque body from behind the pupil, so that the rays of light may be again allowed to pass on to the retina. This object is sought to be effected in one or other of three different ways, according to the circumstances of the case, viz.—1st. By at once extracting the cataract from the eye. 2nd. By lacerating the capsule and dividing the lens, in order that the latter, being exposed to the action of the aqueous humour, may be gradually dissolved and absorbed, and thus eventually removed altogether from the eye. 3rd. By simply displacing it to below the level of the pupil. Of these three different ways, again, there are different modifications.

To make up for the loss of the crystalline lens, the use of spectacles, with strong convex glasses, is required after recovery from the operation.

General observations and questions regarding the operations for cataract.

Prognosis of the operations for cataract in general.—The success of operations for cataract depends very much on the kind of cataract, the age of the patient, and the local and constitutional complications; but as a general estimate, it may be admitted with Dr. Mackenzie, that three-fourths of patients operated on recover useful vision, and two-thirds excellent vision, when such cases only as are fitted for operation are operated on; when the mode of operating is adapted to the particular case; when the operation is well performed, and the after treatment skilfully conducted.

Kind of cataract.—The prognosis in lenticular cataract s much more favourable than in capsular. As to hard nd soft lenticular cataract, the prognosis in them merges nto that of extraction and division.

Age of the patient.—The prognosis is better in young hildren and old persons than in persons in the prime of ife; but this is mainly because it is in early life and old ge that the cataracts most favourable for operation ccur. The general complications connected with age which are unfavourable to the success of operations for ataract, are, in early life, scrofula, and in advanced life, gout.

Complications of cataract.—Before an operation for ataract is determined on, it is necessary to examine not nly the state of the eye in other respects, but the state f the system in general, lest complications should exist which might interfere with the success of the operation. his they might do in two ways, viz., either by intering with its success as an operation simply, or the peration as an operation being successful, by interfering ith the accomplishment of its ultimate object of restoring vision.

The complications which might interfere with the success of the operation as an operation, *i. e.* the successful removal of the cataract, without subsequent injury to the eye from undue inflammation or the like, may be either local, such as entropium, ectropium, trichiasis, ophthalmia tarsi, chronic ophthalmia, or the like; or constitutional, such as disposition to erysipelatous and catarrhal inflammations, scrofula, syphilis, gout, scurvy, chronic diseases of the skin, habitual ulcers of the legs, nervous complaints, delirium tremens, diabetes, and albuminuria.

In regard to local complications it is to be observed, that there are certain morbid states of the eye, which, though they might seriously interfere with the success of an operation as an operation, performed in one way, would be little or no impediment to the success of an operation performed in another way; thus, whilst dissolution of the vitreous body would be incompatible with the success of the operation of extraction, it would offer little or no impediment to the success of displacement or division.

The operation as an operation being successful, local complications might interfere with the accomplishment of its ultimate object of restoring vision, such as defective sensibility of the retina.

Of the different kinds of complications of cataract above enumerated, most admit of cure, or of such palliation as is calculated to remove or diminish the risk of their interfering to prevent the success of an operation. Defective sensibility, or total insensibility of the retina, however, in general admits of no cure, and is therefore of course a complication rendering all operative interference fruitless.

The *diagnosis* of the various complications of cataract above referred to, is either quite evident, or not obscured by the presence of the cataract; but it is different in the case of complication of cataract, with defective sensibility of the retina; for without a careful consideration of all the circumstances of the case, including an inquiry whether, at the commencement, the loss of vision was accompanied by any symptoms of posterior internal ophthalmia (p. 231), and an examination of the eye, with the pupil under the influence of belladonna, the defect of vision might be attributed solely to the cataract, especially as ready perception of light and shade still remains. Exploration of the state of the sight by *phosphènes* (p. 73) should not be neglected. In the case of total insensibility of the retina, the diagnosis is in general easy, seeing that cataract never produces complete blindness (p. 341).

When one eye only is affected with cataract, and the vision of the other good, should an operation be performed?—Under such circumstances, the practitioner will not urge recourse to an operation, and indeed the patient is not likely to desire it; except, as is sometimes the case with young persons, generally females, when the cataract is white and very evident, for the sake of getting rid of the deformity.

When in one eye useful vision is lost, and in the other, vision has become dim from cataract, should an operation be performed at once on the former, or should an operation be deferred until useful vision is lost in the latter also?—It is better to operate at once on the blind eye, in order that sight may be restored in it by the time the other becomes so blind as to require an operation.

When in an elderly person double lenticular cataract has become so far developed as to interfere with useful vision, when should an operation be had recourse to?—If extraction is to be performed, operate as soon as possible, for there is more chance of the vitreous body being sound than at a later period; if, on the contrary, division or displacement is to be performed, the operation may be deferred until the cataracts be more developed.

When cataract is fully formed in both eyes, may both be operated on at the same time?—As a general rule, it is better to operate on one only at a time, if extraction; but on both, if displacement or division, be the operation to be performed.

In cases of fully-formed congenital cataract, at what age should the operation be performed?—It ought to be performed in infancy; and, if possible, before teething commences; if not, soon after teething is completed.

The older surgeons laid great weight on what they called *ripe* and *unripe* cataracts—that is, cataracts fit for operation, and cataracts not yet fit.

It was supposed that the opacity depended on the coagulation of a fluid; and until this process was judged to be sufficiently advanced to permit of the concretion being displaced by the needle, the cataract was deemed unripe. This was an erroneous notion of the nature of the disease; but the practice recommended was in some degree founded on a pathological fact, not however understood.

The operation, in reference to which the distinction of ripe and unripe was made, was couching or depressing the cataract. Now, in the cataract of old people, when the opacity of the lens is fully formed, there is, at the same time, softening of the vitreous humour, and the connections and bands by which the lens is held in its place are so loosened, that it is easy with the cataract needle to depress the lens, by tearing the loosened connections and bands, into the softened vitreous humour.

In an early stage of the cataract, the connections of the lens are still firm and the vitreous humour unsoftened, so that the opaque lens does not admit of being so easily depressed, and if forced down it is apt again to rise. This constitutes unripeness of the cataract.

Ripeness or unripeness of the cataract has no bearing on the operation of extraction, unless it be in a contrary sense; for when the cataract is very ripe for couching, the case is not very safe for extraction on account of the softened state of the vitreous humour; whereas, when the cataract is as yet unripe for couching, the eye is in the fittest state for extraction. Hence it is advisable, if the operation of extraction is to be performed, to operate as soon as the dimness of sight is such as to call for interference.

Preparation of the patient for undergoing an operation for cataract.—If the case be free from local or constitutional complications, the patient requires no other preparation than a few days' rest of mind and body, some attention to diet, and to the state of the bowels. If, on the contrary, any such complications exist, he ought, before the operation is undertaken, to be subjected to such treatment as is adapted either to remove them altogether, or to palliate them so far as to remove or diminish the risk of their interfering to prevent the success of the operation. The previous habits of the patient as to diet, the use of strong drinks, smoking, &c., should be carefully considered.

The treatment of the morbid states of the eye, which may complicate cataract, is discussed under their proper heads. In regard to the treatment of the various constitutional complications, it would be out of place here to enter into detail. It is proper, however, to observe, that in some cases the abstraction of blood may be necessary, besides restriction of diet, even to abstinence from all strong drink, and animal food too, though in these respects care should be taken not to interfere violently with confirmed habits. For the regulation of the bowels, repeated purges may be required. In other cases, strengthening diet and tonic and even stimulating treatment may be called for.

It need scarcely be remarked, that if the patient is subject to gout, rheumatism, or erysipelas, the operation should be carefully avoided, when there is reason to fear an attack is impending. Shortly after an attack, is the occasion which should be chosen. In any case, the operation is not to be undertaken while the patient has a foul tongue.

On the morning of the operation, if there is no natural evacuation, a clyster should be given to procure one.

The only special preparation of the eye for the operation is the dilatation of the pupil, by means of the softened extract of belladonna, smeared on the eyebrow and eyelids, two or three hours before, or, what is more convenient, the atropia solution dropped into the eye.

Seasons of the year best adapted for operations for cataract.—The operations for cataract may be performed during mild and steady weather at any season. Very cold and very hot weather are equally unfavourable. Cold east winds are especially so.

Position of the patient, assistants, and operator.—The patient may either sit on a chair, or he may lie extended on a sofa or table with a pillow under his head. In infants great advantage is obtained by bringing them under the influence of chloroform,* otherwise they are best secured by wrapping them in a shawl, to confine their arms and hands, and laying them on their backs on a table. In very timid adults also, chloroform may be occasionally resorted to, at least in operations with the needle, the vomiting which is liable to supervene being an objection of great weight to its employment in extraction.

When the patient sits, the operator usually stands, or, if he sits, it is on a high chair, whilst an assistant stands behind the patient, to support his head, and to take charge of the upper eyelid. The patient's head should be held with the face looking somewhat upwards;

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* Here Dr. Atlee, the American editor of this work, remarks that he decidedly prefers sulphuric ether in most cases, using, if desirable, sometimes, a small proportion of chloroform along with it.

and in order to secure it in this position, the assistant supports it against his breast, and holds the chin by one hand, whilst the other—the right if the right eye, the left if the left eye is the subject of operation—rests on the forehead; with the latter hand the assistant secures the upper eyelid. The operator takes charge of the lower eyelid, and for this purpose he uses the forefinger, the middle finger being applied to the inner corner, ready to prevent the rolling inwards of the eyeball, the ring finger is bent to be out of the way, the little finger rests on the patient's opposite cheek; with the right hand the operator holds the instrument, if it is the left eye which is to be operated on, and *vice versa*. When the patient lies extended on a sofa or table, the operator stands at his head; in which case, with one hand resting on the forehead, he secures the upper eyelid, whilst with the other he holds the instrument.

If the operator is not ambidexter, he, when the patient sits, can conveniently operate only on the left eye. When the patient lies extended on a sofa or table, the operator stands behind the head, and takes charge of the upper eyelid, if it is the right eye which is to be operated on. But if the left, then he must stand by the side of the patient; in this case, the assistant stands at the head, and secures the upper eyelid; the operator himself depressing the lower.

In operating on the eye, it is of the greatest moment to have good light. A window directed to the north should, if possible, be chosen. At any rate, the light admitted by it should be diffused and subdued by a muslin gauze blind. If there be more than one window in the room, the others should have the curtains drawn over them. In regard to the position of the patient to the light, it should be such that neither the operator's body nor his hand be interposed between the eye and the light during the operation. It should also be such, that the light is not reflected from the cornea, so as to disturb the operator's view.

Opening and securing of the eyelids.—The patient, assistant, and operator being in their places, the next business is to open and secure the eyelids. The proper securing of the upper eyelid is a most important point; it is effected by applying the points of two fingers, the fore and middle, or the middle and ring finger, according to circumstances, against the broad border of the tarsus, the eylashes being smoothly extended between the eyelids and the surface of the fingers, and gently raising the eyelid, by sliding its firm part back under the margin of the orbit, until the fingers come to press against that margin. The upper eyelid may thus be completely secured without any great force, and without the slightest pressure on the eyeball, without the eyeball even being touched.

The lower eyelid is secured in a similar manner, and still more easily, with the forefinger, whilst the middle finger is applied over the caruncle. Fig. 65.

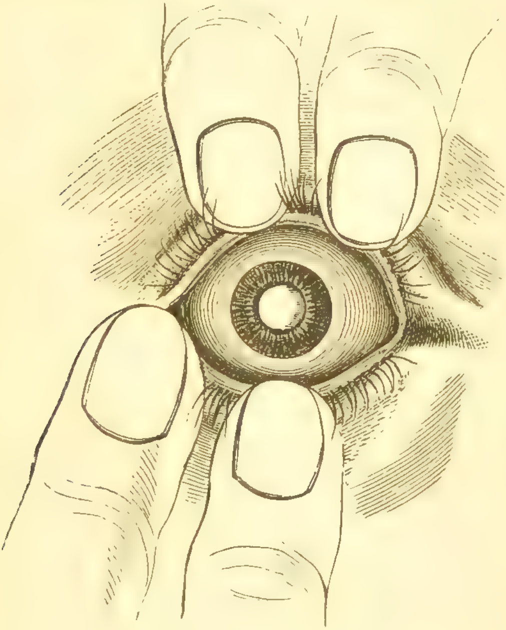

Fig. 65.

It is seldom necessary to employ a speculum for securing the upper eyelid.

When the eyelids are held apart unskilfully, they are apt to become everted, while folds of the conjunctiva are thrust out between them by the action of the orbicularis muscle, so that the front of the eyeball is almost buried, and the operation consequently impeded.

A compress of charpie is laid over the closed lids of the eye not operated on, and secured by a roller. If, however, the patient has complete command over himself, the eye should be left uncovered, that he may keep his gaze fixed on some point, and thus properly direct and steady the eye to be operated on.

As some uneasiness attends the proper securing of the eyelids, the patient is apt to flinch at it. For some days before the operation, therefore, it is advisable to practise on the eye, the manœuvres of opening and securing the eyelids and steadying the eyeball, in order to accustom the patient to bear these manipulations without flinching, and to keep the cornea directed straight forward. There is always at first a great tendency to turn the cornea up under the upper eyelid. The patient is at the same time to be seated as it is proposed he should be at the time when the operation is actually performed.

The patient having by this important preparation acquired command over the movements of the eye, the operation may be proceeded with. When we cannot calculate on the patient being sufficiently steady, the conjunctiva, a little below the cornea, may be grasped in a large fold with a forceps, and the eyeball thereby prevented from rolling upwards and inwards. Fig. 72, p. 368.

EXTRACTION OF THE CATARACT.

Extraction may be effected through an incision, either in the cornea or in the sclerotica. Extraction through an incision in the cornea, is the operation commonly practised; extraction through a sclerotic incision not having been found so successful. Siliquose cataract and shreds of opaque capsule are, however, sometimes successfully extracted through a small opening in the sclerotica.

1st.—*Extraction of the hard or common lenticular cataract of old persons through a semi-circular flap-incision of the cornea.*

In the common hard lenticular cataract of old persons, the operation it is most advisable to perform, when circumstances admit of it, is extraction through a semi-circular flap-incision of the cornea.

The operation is a nice and difficult, though not very painful, one, and for its success an otherwise healthy condition of the eye is of great importance.

Conditions necessary for, or at least favourable to the successful performance of the operation.—1. Steadiness on the part of the patient during the operation diminishes to the surgeon the difficulties attending its performance, whilst after the operation, it is calculated to promote the healing process, and to ward off the occurrence of such accidents as are liable to interfere with that process, and so mar success. 2. Wide palpebral fissure, so that the eyelids may be sufficiently separated to permit the due exposure of the whole front of the eyeball. 3. The eyeball neither much sunk nor very prominent: in the one case the section of the cornea cannot be well made; in the other, the healing of the wound does not proceed so favourably. 4. The cornea, healthy in structure (an *arcus senilis*, p. 23, is no impediment), and of due size and prominence. 5. The iris, free from synechia, and not inclined towards the cornea, so that the anterior chamber may be of good depth. 6. The pupil natural, freely contracting and dilating according to the degree of light.

Conditions unfavourable to, or wholly forbidding, the performance of the operation.—Unsteadiness on the part of the patient; disease of the heart; chronic cough; difficulty of breathing; very over-hanging superior orbital margin and eyebrows; narrow palpebral fissure; very sunk or very prominent eyeball; the cornea unhealthy in structure, small and flat; the anterior chamber consequently small; synechia; small pupil, and not widely dilatable, even by belladonna; or, and above all, a dissolved state of the vitreous body and its connections.

When a dissolved state of the vitreous body exists, as it often does in old persons, the section of the cornea is, perhaps, no sooner made than the cataract, along with a greater or less quantity of the vitreous humour, bursts out from the eye; or, the cataract sinking down behind the iris, a large quantity of vitreous humour alone bursts out. If the softening be great, the vitreous body will be evacuated wholly or in large quantity, and the eyeball may thus be destroyed, notwithstanding the utmost dexterity, delicacy, coolness, and circumspection on the part of the operator. But how is the existence of this state of the vitreous body ascertained before operation? (See p. 282.)

If during the operation of extraction on one eye, any indications of softening of the vitreous body should be observed, this ought to be a warning against proceeding at once to operate on the other; because, during the second operation, the muscles of the eyes and eyelids are apt to be involuntarily contracted, and the vitreous humour of the eye already operated on squeezed out.

It is to be observed, that in the eye in which the cataract has more lately formed, the vitreous body is less likely to be softened than in the other; so that, supposing it to be determined to operate by extraction on both eyes at the same time, it would be advisable to operate first on that in which the cataract has more recently formed.

Prognosis.—When the case is one of common hard lenticular cataract, and when the other conditions are favourable, the prognosis is good. Recovery of the eye, from the effects of the operation, ordinarily takes place in less than three weeks; but not unfrequently, some degree of external, or even anterior internal inflammation occurs, so that recovery is retarded. In general, convalescence should not be calculated on sooner than from four to six weeks; in some cases dangerous and destructive inflammation occurs, although the case appeared to be in all respects a proper one for operation, and the operation well and successfully performed.

The operation having succeeded as an operation, more perfect vision is in general obtained after extraction than after any other mode of operating.

Instruments and dressings.

A Beer's knife, for making the section of the cornea.* (Fig. 69, p. 366.)

A set of two pairs of Daviel's scissors (Figs. 78, 79, pp. 375, 376), for enlarging the corneal incision, if necessary, or the probe-pointed knives more commonly used for the purpose. (Figs. 73, 77, pp. 372, 374.)

A sickle-pointed needle, or simple bent point, for lacerating the capsule. (Fig. 91, p. 398, or 80, p. 377.)

Daviel's curette or spoon. (Fig. 81, p. 377.)

A fine hook (Fig. 82, p. 379), or slender-bladed forceps (Fig. 36, p. 152), for extracting or assisting out the lens, in case of its sinking in the vitreous humour.

Strips of skin isinglass plaister, about an eighth of an inch broad, and long enough to extend from the eyebrow to the cheek, over the eyelids.

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* The sharpness of the point of the knife is tested by making it pierce very thin leather put on the stretch. If the knife pierces without force, and without making any noise, the point is good.

Some small pieces of lint.

The operation of extracting a lenticular cataract, through an incision in the cornea, may be viewed as comprehending two principal parts, viz., 1st, *the section of the cornea;* and 2nd, *the laceration of the capsule, and extraction of the lens.*

Section of the cornea.—This is usually considered the nicest, if not the most difficult part of the operation. It is made concentric with the margin of the cornea, and, in order to be of sufficient size for the escape of the lens, about one-thirtieth of an inch from the sclerotica, and to an extent corresponding to about half the circumference of the cornea. This section may be made in the lower half of the cornea (Fig. 66), or the upper half (Fig. 67), or the outer and lower half (Fig. 68), thus:—

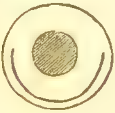

FIG. 66.

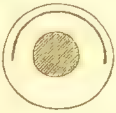

FIG. 67.

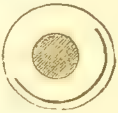

FIG. 68.

The instrument usually employed for making the section of the cornea is Beer's cataract knife, which is represented in Fig. 69, p. 366.

The back of the blade *a* is straight with the handle, the cutting edge *b* oblique, and forming with the back at the point *c* an angle of about 18° or 19°. For about one-tenth of an inch from the point the back is cutting, as well as the edge.

The back of the blade generally, though blunt, should be thin, but in a line between the back and edge, extending from point to heel, the blade is thick, the thickness increasing gradually from point to heel on the one hand, and from the edge and back respectively on the other. The line in the direction of which the thickness is greatest, is indicated by *d*. This conformation imparts the necessary rigidity to the blade, and is farther of use, during the performance of the operation, in filling up the incision as it is made, and thus preventing the premature escape of the aqueous humour, until the section of the cornea is nearly completed, which is a very important condition for its successful performance.

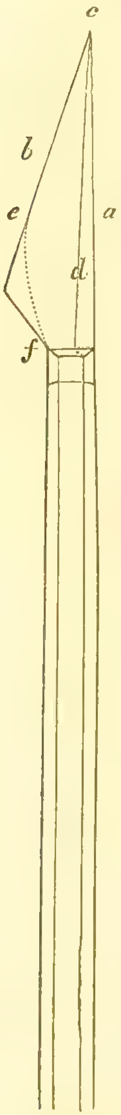

FIG. 69.

It may be remarked, that the great breadth of the blade towards the heel is quite unnecessary for the completion of the section of the cornea, as may be seen in Fig. 70, and is sometimes positively inconvenient during the operation, by coming into contact with the edge of the eyelid. All the part, therefore, comprised between *e* and *f*, Fig. 69, might be advantageously cut away as far as the dotted line.

The handle of the knife should be broad, as much as one-fifth or one-fourth of an inch broad, and flat, the flat sides to correspond to the flat surfaces of the blade.

The mode in which the section of the cornea is made with the knife, which has now been described, is to pierce through the cornea on the temporal side into the anterior chamber, which constitutes the act of *puncturation;* then to push the point of the knife, the flat surfaces of the blade being to and from the operator, through the anterior chamber, across to the nasal side of the cornea, where the point of the knife is again made to pierce through the cornea from the anterior chamber, an act called *counter-puncturation.* By now continuing to push the knife onwards, it, by its increasing breadth, *cuts itself out* in the direction of the dotted line (fig. 70, p. 367), and so the section of the cornea is completed. The section of the cornea thus comprehends three acts, viz., *puncturation, counter-puncturation*, and *cutting out.*

Method of holding the cataract knife.—The handle is to be held not exactly in the middle, but rather nearer the blade: its flat surfaces between the points of the fore and middle fingers on the one side, and the point of the thumb on the other, and the general direction

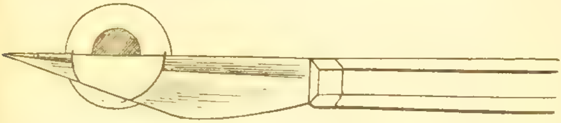

FIG. 70.

of the handle somewhat at right angles to the thumb. (Fig. 71).

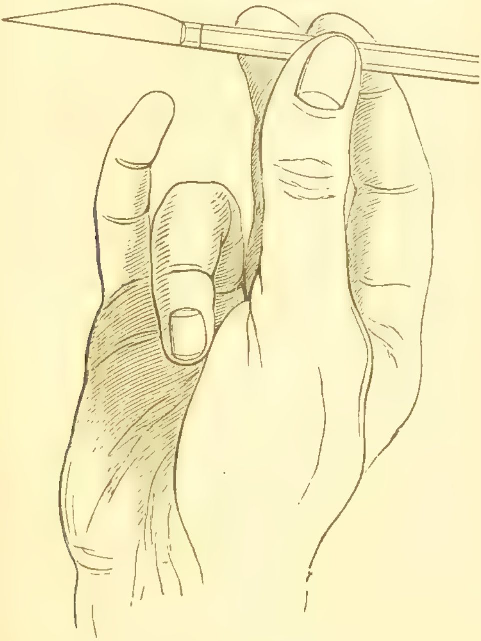

FIG. 71.

By having the handle of the knife broad and flat, and by holding it in the manner just described, it is not liable to roll betwixt the fingers, and the little finger resting on the patient's cheek, all the manœuvres after puncturation can be so executed that the surfaces of the blade shall be kept unerringly parallel to the surface of the iris and the base of the cornea, during the passage of its point through the anterior chamber: consequently its edge will have no tendency either to cut abruptly out from the cornea, or, on the contrary, to be so inclined as to come upon the sclerotica, and cut out there.

Preparatory to the operation, the pupil should be dilated by atropia (p. 359). The principal advantage of this is, that the section of the cornea is facilitated by the depth of the anterior chamber being increased in consequence of the retraction of the pupillary circle of the iris from contact with the prominent centre of the lens, by which it was somewhat pushed forward. As

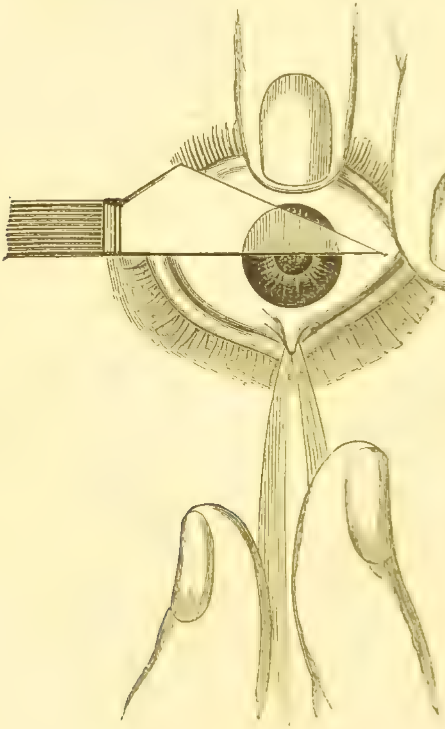

FIG. 72.

soon as the aqueous humour is evacuated, the pupil contracts.

Should there be reason to fear that the patient will not be able to keep his eye steady, it ought to be held drawn down with a forceps grasping a fold of the conjunctiva and subconjunctival cellular tissue at some distance from the lower margin of the cornea, as represented in the annexed diagram, from Mr. France. The forceps, it will be seen, while maintaining the globe in position, keeps the lower lid depressed.

Fig. 72 illustrates the operation at the moment when the forceps, having fulfilled its purpose, should be withdrawn.

The position of the patient, assistant, and surgeon, being arranged as above recommended (p. 359, *et seq.*), the operation is proceeded with as follows :—

Section of the cornea downwards.—Puncturation.—The surgeon, holding the cataract knife in the manner above described, and with its back upward and horizontal, rests the hand by means of the little finger on the patient's cheek, in such a way, that the blade of the knife may be by its corresponding flat surface close in front of the cornea, and with its point as far advanced towards the nose as it must be, not only when counter-puncturation is effected, but when the knife has almost cut itself out.

Things being thus disposed, the surgeon, after touching the cornea with the flat surface of the blade of the knife to see whether or not the eye is disposed to start, and warning the patient not to hold his breath when the knife pierces, prepares for puncturation, by turning back the hand and retracting the fingers, holding the knife so that the point of the instrument may be brought opposite, and somewhat perpendicular to, the point of the cornea where puncturation is to be made, viz., about one-thirtieth of an inch from the temporal margin, and as much above the transverse diameter.

Watching his time, then, when the eye is directed steadily forward, and a little outwards, the surgeon, by a quick but assured movement, enters the knife at first somewhat perpendicularly to the surface of the cornea, but just as it is about to penetrate, and thus gain the anterior chamber, the handle of the knife is to be inclined backwards, by bringing the hand into its former position, so that the surfaces of the blade may become parallel to the iris and base of the cornea. At the same time that this manœuvre is executed, the handle of the knife is to be inclined a little downwards, so that the point may be directed a little upwards, as if to make counter-puncturation at a point higher than is really intended, otherwise, in consequence of the depression which the point of the knife necessarily experiences in its progress towards the opposite side of the cornea, counter-puncturation would fall too low, and the section of the cornea would consequently be too small.

The perpendicular direction recommended to be given to the point of the knife, in commencing puncturation, is to obviate the risk of the point of the knife being thrust obliquely into the substance of the cornea instead of penetrating directly through it into the anterior chamber. That the knife has been thrust into the substance of the cornea, and not penetrated into the anterior chamber, is readily perceived by the dull-looking way in which the knife shines through, in comparison to what it does when it is fairly in the anterior chamber; and also by the continuance of resistance to the onward progress of the knife. All this can be readily illustrated by practising on the eye of a sheep or pig.

Passage of the knife across the anterior chamber, and counter-puncturation.—Immediately on puncturation being effected, the knife is, without any pause, pushed steadily and quickly on through the anterior chamber to the opposite side of the cornea, and counter-puncturation made. The point of the cornea where this should take place is one-thirtieth of an inch from its nasal margin, and corresponding to, or a little above, the transverse diameter, and ought to be steadily kept in sight by the operator.

Cutting out.—Neither between puncturation and counter-puncturation, nor between counter-puncturation and the first stage of cutting-out, should there be any pause. In pushing the knife on in order to cut out, its edge must not be pressed down against the substance of the cornea which it is cutting, but, by lowering somewhat the handle, the back of the knife should rather be kept pressed up against the upper angle of the wound of counter-puncturation. By this means the blade of the knife is made to fill both the incision and counter-incision in the cornea in proportion as it makes them, and thus no room is given for a premature escape of aqueous humour.

When the knife has almost cut itself out, and there is no longer any danger of the iris falling in the way of its edge, a pause is to be made. The surgeon, having now complete command over the eyeball, makes it turn rather outwards if, in completing the section of the cornea, the point of the knife threatens to come upon, and be stopped by, the parts at the inner canthus. After this, the tag of the cornea which remains is to be slowly and cautiously cut by a sawing motion. The upper eyelid is at the same time to be let go, and as soon as the tag is cut and the knife withdrawn, the lower eyelid is to be allowed to rise, care being taken that its border does not interfere with the corneal incision.

Whilst the cutting out is thus being accomplished, the patient is to be cautioned not to hold his breath, or make any effort to squeeze the eyelids together, for at this moment the lens, with a portion of the vitreous body, if the latter is at all in a dissolved state, is apt to burst out. For fear of this it has been advised to leave the tag of cornea uncut, allow the eyelids to close, and cut the tag only after laceration of the capsule has been effected; but this is a proceeding not at all to be recommended, for vitreous humour may escape though the lens is retained. And when the tag is cut, the lens may not be so easily removed without further loss of vitreous humour.

If, in cutting out, the iris should fall against the edge of the knife, in consequence of premature escape of aqueous humour, the surgeon should pause, and whilst pulling the eye forwards with the whole knife, apply the point of the middle finger against the cornea, and try by gentle pressure to disengage the iris from the edge of the knife, and to keep it so until the section is nearly completed. If this does not succeed, and if much of the iris lies before the edge of the knife, this instrument may be withdrawn, and the section completed as well as possible with the probe-pointed knife, or Daviel's scissors. But if a small part merely of the iris lies before its edge, the knife ought to be pushed on, even although the piece of the iris be cut off. If in this excision of a piece of the iris the pupillary margin is not included, and an opening is made, this and the pupil should be thrown into one by dividing the isthmus with Maunoir's scissors before extracting the lens. Excision of a bit of the iris is of no consequence. Nay, it appears to be advantageous rather than otherwise.

Section of the cornea upwards.—This has of late years been the method preferred. The procedure differs from that above described only in the circumstances, that the edge of the knife is directed upwards—the back, which is directed downwards, as in the former case, being horizontal—and that the points of puncturation and counter-puncturation should be *below* instead of *above*, the transverse diameter of the cornea. In this case also greater care is required at the time of completing the section of the cornea, in withdrawing the knife, and allowing the upper eyelid to fall down, for in consequence of the tendency of the eyeball to roll up suddenly, the flap of the cornea is apt to be caught either by the knife or by the edge of the upper eyelid, and to be folded down.

Section of the cornea in its outer and lower half. — This was the section generally adopted by the first Wenzel (who used a double-edged knife for the purpose), and was again pretty extensively practised by the late Professor Rosas, of Vienna (who used a Beer's knife, with a sharp-cutting back), and the late Mr. Tyrell, who used the common Beer's knife. To effect the section, puncturation is made on the temporal side, 45° above the horizontal diameter of the cornea, and counter-puncturation below the horizontal diameter on the nasal side; so that of the semicircular incision, one-fourth is above, and three-fourths below, the horizontal diameter.

Completion of the section of the cornea.—If, in consequence of the iris having fallen against the edge of the knife, it has been necessary to withdraw this instrument, the section of the cornea is best completed with the probe-pointed convex-edged knife (Fig. 73). It is to be en-

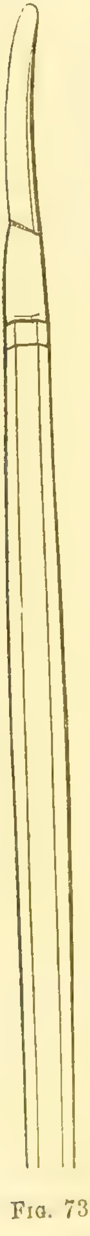

FIG. 73.

tered into the anterior chamber by the wound of puncturation, and its blunt point run close along the posterior surface of the cornea until it passes out by the wound of counter-puncturation. (Fig. 74.) The convex edge of the

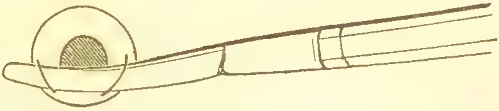

Fig. 74.

knife approaching so near the part of the cornea to be cut does not leave room for the iris to fall against it, while by a sawing motion the section is completed.

The incision made in this manner by a knife heals better than one made by scissors. If, however, the surgeon finds he can effect his purpose more easily by means of Daviel's or even the common curved scissors, the disadvantage attending a division made by them is, on the whole, not so great as to deter from their employment. Daviel's scissors, and the mode of using them in enlarging the section of the cornea when too small, are described below.

Enlargement of section of the cornea when too small.—The section of the cornea may prove too small, either in consequence of the incision being too much within the margin of the cornea, thus (Fig. 75)—

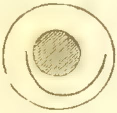

Fig. 75.

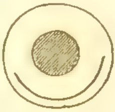

Fig. 76.

or not extending to the half of the circumference, as Fig. 76. The first mentioned defective section can scarcely be remedied, the second may be so very readily.

For enlarging the section of the cornea when too small, either a probe-pointed concavely-curved edged knife, such as is represented in Fig. 77, p. 374, or a pair of curved scissors may be employed (pp. 375, 376).

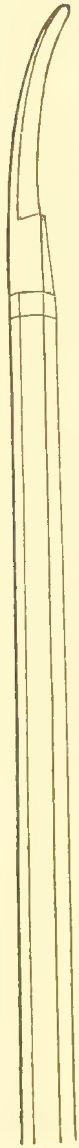

Fig. 77.

When the knife is used, it is held as the cataract knife, and is introduced through the incision of the cornea flatways, its round and blunt point gliding against the posterior surface of the cornea, contact with the iris being avoided as much as possible, and its edge directed against the angle where the incision is to be enlarged. By withdrawing the knife a little, the cornea is cut; the knife being again pushed in, it is again a little withdrawn, and an additional cut made, and so on, cutting only on withdrawing the knife, until the wound is sufficiently enlarged, and that as much as possible in a line concentric with the margin of the cornea.

When scissors are had recourse to, Daviel's are those recommended, though a pair of simple blunt-pointed curved scissors will answer the purpose. Daviel's scissors have a double curve, to adapt them to make as direct a snip of the cornea as possible. Two pairs bent in opposite ways are consequently required. One pair to enlarge the incision, supposing the section downwards, on the temporal side of the right eye, and on the nasal side of the left; or supposing the section upwards, to enlarge the incision on the temporal side of the left eye, and on the nasal side of the right. Another pair to meet the opposite circumstances. (Figures 78 and 79, pp. 375, 376.)

The way in which the scissors are to be held is this:—The thumb in one ring, the ring-finger in the other, the point of the fore finger on the joint, the middle finger on the branch in the ring of which the ring-finger is. The thumb and ring-finger may be inserted into the rings either from the convex or concave surface of the scissors, according to circumstances; but the convexity of the instrument ought of course always to be towards the eye.

Supposing the eye operated on to be the left, that the section of the cornea is downwards, and that it is on the temporal side.

the incision is to be enlarged, the pair of scissors to be used is that which, when held as above described, will present the concavity of its lateral curve towards the centre of the cornea. The blades then being sufficiently open, the point of the one next the centre of the cornea is to be introduced flatways behind the flap of the cornea, and carefully slid up between the cornea and iris to opposite that part of the circumference of the cornea which is to be cut.

There are now two precautions to be observed:—

1st. In order to avoid haggling, the edges of the scissors should be directed, as much as possible, at right angles to the part to be cut, which is done by turning the scissors a little on their axis towards the nose.

2nd. In order that the cut may be made as large as is desired at one stroke, their points should extend somewhat beyond the point in the cornea to which it is wished to enlarge the incision, because during the stroke

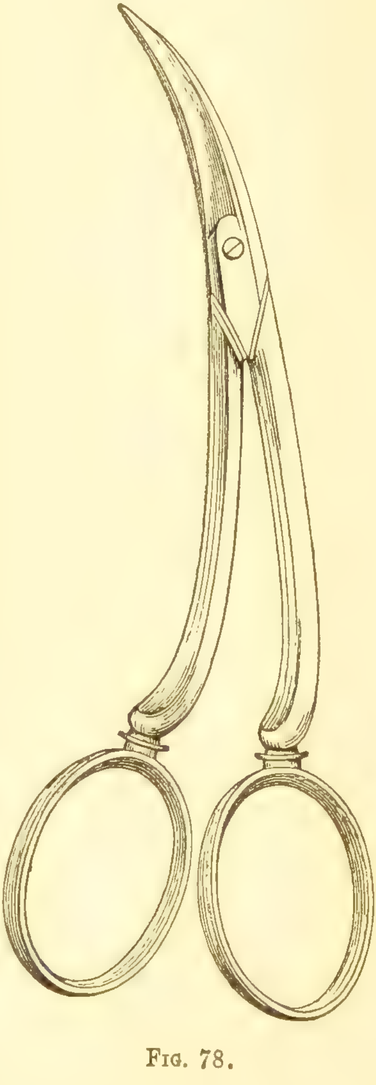

Fig. 78.

the instrument necessarily slips somewhat back.

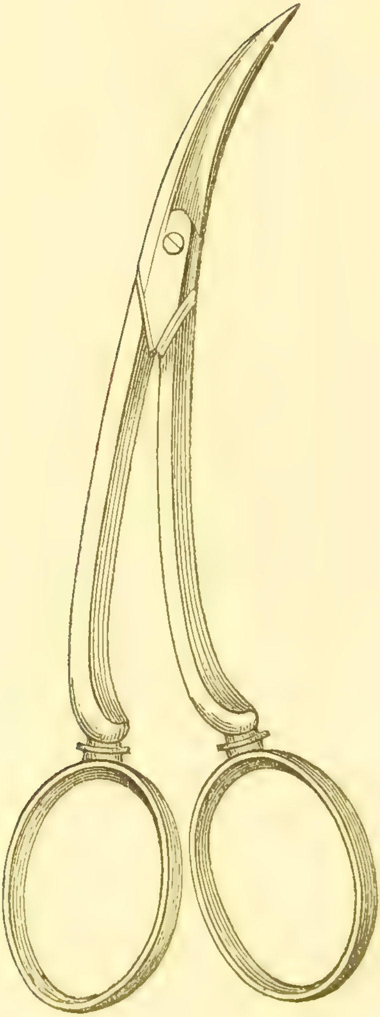

FIG. 79.

General observations on the precautions to be observed in making the section of the cornea.—According to the direction in which the edge of the knife is inclined, when it pierces the cornea, and is passing across the anterior chamber, so must that of the section be. If the knife is properly held and entered, all that the surgeon has to do in carrying it across the anterior chamber, is to watch the point of counterpuncturation, so that that may be made at the proper place; this being effected, all that is now required is to push the knife steadily on in the manner above described, and it inevitably goes right. But if it has been ill entered at first, though the deviation of its surfaces from parallelism with the surface of the iris and base of the cornea may have been very slight, the deviation of the edge from the right direction of course increases with the progressive movement of the knife, and then if attempts are made to bring the knife again into a proper direction, they cause the opening in the cornea already made to gape, and thus the aqueous humour is allowed to escape, so that the iris falls against the edge of the knife.

If the faulty direction of the edge of the knife is such that it will cut out too soon, so that the section will turn out too small, the operator should nevertheless proceed, and enlarge the incision afterwards. If, on the contrary, the direction of the edge of the knife is too much inclined towards the sclerotica, so that if the knife were pushed on it would cut both it and the conjunctiva, it should be withdrawn in time, and the section of the cornea completed with the probe-pointed knife or Daviel's scissors.

Laceration of the capsule, and extraction of the lens, when the downward section has been made.—Different shaped instruments are in use for lacerating the capsule; sickle-shaped (Fig. 91, p. 398), or straight broad pointed cataract

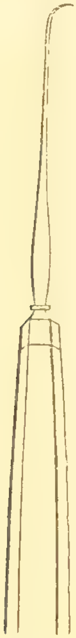
FIG. 80.

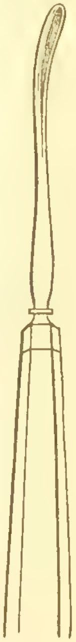
FIG. 81.

needles, but the simplest instrument is one like a common sewing needle, bent at the point (Fig. 80, p. 377). The instrument, of whatever form it may be, is commonly fixed on the same handle with the curette (Fig. 81, p. 377), which is employed for assisting in the extraction of the lens.

The assistant having gently raised the upper eyelid, without making the slightest pressure on the eyeball, and the patient being directed to turn the eye a little upwards, the surgeon with one hand depresses the lower eyelid, and with the other slips the bent needle with the convexity of its curve first behind the flap of the cornea, until opposite the pupil, and then up as far as he can behind the iris. This being done, he rotates the handle of the instrument so as to turn the point against the upper part of the cataract. By a rotatory movement now of the handle whilst held horizontally, he makes the point of the instrument lacerate the capsule from above downwards as far as the middle. He next, in a similar manner, lacerates the lower part of the capsule by a stroke from below.

In its natural state, the capsule, when punctured merely, will readily tear and allow the lens to escape; and although in lenticular cataract the same thing will often take place, it is proper not to trust to this, but to take pains to lacerate the anterior capsule freely, as just described.

The capsule having thus been freely lacerated, the instrument is to be carefully withdrawn with its convexity foremost, so as not to hook the iris or cornea.

It often happens that immediately on the laceration of the capsule, the lens begins to escape; if it does so, the surgeon will at once proceed to help it out in the manner to be described below; but if it does not, the eyelids are to be allowed to fall together for a minute or so before the extraction is proceeded with.

In the former case, the assistant still keeps the upper eyelid carefully elevated without making pressure on the eyeball, whilst the operator, continuing to keep down the lower eyelid with one hand, takes the curette in the other, and watches the progress of the escape of the lens, the advance of its lower edge through the pupil, its clearing the pupil, and its final escape through the incision of the cornea. Whilst this is going on, the patient is to be directed to turn the eyeball upwards. No farther interference may be required, but if necessary, gentle pressure is to be made on the lower part of the eyeball, at some little distance from the margin of the cornea, and this may be done either by the surgeon pressing the margin of the lower eyelid which he is holding against the eyeball, or employing the curette for the purpose.

In the latter case, after the pause, the eyelids are opened as before, and the patient being directed to look upwards, the surgeon makes gentle pressure on the lower part of the eyeball, when the lens will be seen to slide by its lower edge through the pupil, which it stretches, to raise the flap of the cornea, and finally make its escape through the incision. If its escape through the incision of the cornea should be stopped, the lens is to be helped out by the bent point or by the curette from between the lips of the incision.

Laceration of the capsule, and extraction of the lens when the upward, or the downward and outward section has been made.—This part of the operation is effected in a manner essentially similar to that above described for the downward section; only in the one case, the laceration of the capsule is to be made from below upwards, and in the other from above downwards to below and outwards. In the extraction of the lens again, the patient should in the one case be directed to turn the eye downwards, and any pressure on the eyeball, which may be necessary, is to be made with the curette on its upper part; whilst in the other, the patient turns the eye inwards and upwards, and pressure with the curette is made on the lower and outer part of the eyeball. In these cases, moreover, it is best for the surgeon to take charge of the upper eyelid, whilst the assistant depresses the lower.

In its passage out, some of the soft exterior of the lens is often stripped off and retained in the aqueous chamber. No attempt, at least no prolonged attempt, need be made to remove this, as it becomes by-and-by absorbed.

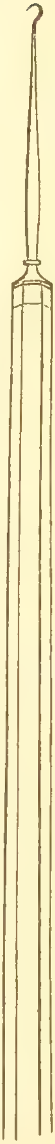

FIG. 82.

If, however, the lens should break in pieces, and a considerable piece be left in the anterior chamber, it ought to be scooped or hooked out. Care should be also taken that no fragment of the lens is left between the edges of the wound.

If, after laceration of the capsule and moderate pressure on the eyeball, the lens does not advance, the surgeon must consider whether or not the section of the cornea is large enough, and whether or not the capsule has been sufficiently lacerated. If he is assured that everything is right in these two respects, he will leave the patient's eye closed and at rest for a minute or two, and then repeat the manœuvres to effect the extraction. Should these fail, an attempt is to be made to extract the cataract with the scoop or a hook (Fig. 82, p. 379).

The lens having been extracted, the eyelids are again allowed to close. After a few minutes' rest to the patient, the surgeon gently opens the eyelids to see if the iris and flap of the cornea are in their proper position, and the pupil clear. If the iris and pupil do not appear to be quite right, the upper eyelid is allowed to close, and is to be rubbed gently with the finger over the front of the eyeball, and then quickly opened to the light, when the iris will contract, and will thus, along with the pupil, be brought into a proper situation. This being the case, and the flap of the cornea in accurate apposition, the eyelids are to be closed—first the upper and then the lower.

Bandaging of the eye and treatment after the operation.—The flap of the cornea lying in proper apposition, the eyelids are to be closed. The upper eyelid is allowed to fall slowly over the eye, when the upper section has been made. If it has been the lower section, it must be carefully seen that the edge of the lower lid does not interfere with the lower part of the flap; if it does so, the lower lid should be kept somewhat retracted by a strip of plaister, extending from it down on the cheek.

Both eyes are to be kept closed, and for this purpose a narrow strip of isinglass plaister, extending from the eyebrow to the cheek, is to be applied over the eyelids on each side; whilst over all a shade composed of a fold of soft linen, to which is fixed a tape to tie round the head (Fig. 83, p. 381), is to be hung.

Another method of bandaging is to lay over the eyes when closed a light compress, and secure it by a band, the middle of which is laid over the nape of the neck, and the ends brought over the eyes, crossed on the forehead and pinned to each other behind.

The patient need not be put to bed immediately after the operation, unless he desires it, but may recline on an easy chair or sofa, until about his usual bed-time. The room should be somewhat darkened, and perfect quietness observed in the house. The patient should refrain from speaking, and endeavour to keep himself as composed as possible. His food should be so prepared as not to require much chewing.

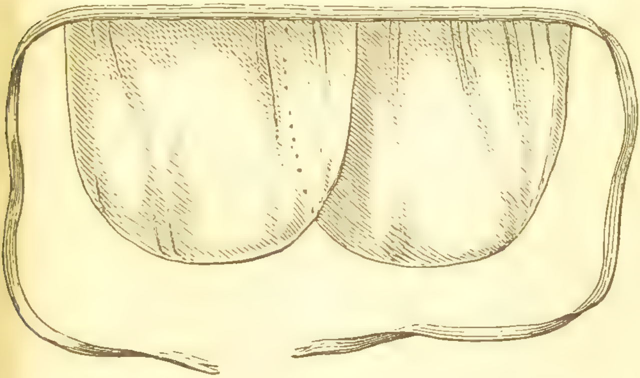

FIG. 83.

At bed-time an opiate should not be omitted, if the patient is in the habit of taking one to procure sleep; if not in the habit, an opiate is to be given only if the patient is restless.

It used to be the practice to bleed the patient to ℥viij. or ℥xvj., on the evening of the operation, if he had not been bled before; but this is unnecessary, if the patient s, as he should be, in a proper condition at the time of he operation. It is time enough to take blood when ymptoms of undue inflammation, such as pain in the ye, redness, and swelling of the eyelids, begin to manifest themselves; and these symptoms ought to be carefully watched for from day to day. The third or fourth day is he time at which they most generally occur.

During the night the patient should be watched, lest by turning in bed or rubbing the eye with his hand while asleep, the eye should be injured. A good precaution is to secure the patient's hands to his side, so far that they may be prevented from being carried to the eye.

The patient should not go to stool for the next day or two succeeding the operation, if this can be avoided. If not, he ought to bear well in mind to move with the greatest caution, and that he must not make the slightest straining effort. Irremediable injury to the eye, by hæmorrhage, protrusion of the iris, &c., has been the result of such want of care. After three days, some laxative medicine may be taken, if necessary.

The patient should lie on his back until at least the third day, when, if matters go on well, he may sit up in bed. On the fourth day, he may be allowed to get out of bed for a few hours in the afternoon.

During the twenty-four or forty-eight hours succeeding extraction, the patient feels a soreness in the eye, as if he had received a blow on it, and also from time to time experiences a slight pricking, smarting and pressing sensation, which is always relieved when a watery fluid, partly tears, partly aqueous humour, escapes from the eye. From these and incrusted Meibomian secretion, the eye is to be on the third day carefully cleansed with tepid water and a soft linen rag. The eye is not to be opened until the fourth or fifth day, but that things are going on well may be inferred if there is no pain, and the upper eyelid neither red nor swollen. On the fourth day, after the borders of the eyelids have been cleansed from any adherent matter, by means of tepid water, and a bit of soft lint, as just mentioned,—the strips of plaister, if they have been used, removed,—and the parts gently dried, the eye may be opened and looked at. In opening the eye on this occasion, we first draw the lower eyelid downwards and then cautiously raise the upper, whereupon if matters have gone on well the cornea will be seen plump and clear and the pupil black.

The eye is to be quickly closed and not looked at again for two days, and so on, until the tenth or twelfth day. After that, the eyes being protected by a shade, the patient may freely open them.

The corneal incision heals in the course of two or three days or even sooner, if there is nothing to prevent union by the first intention, such as prolapsus iridis, with or without prolapse of the vitreous body, or non-apposition of the edges of the incision. The incision, when enlarged by scissors, is apt not to heal completely by the first intention.

Untoward occurrences during the operation.—If, before counter-puncturation is effected, the aqueous humour should escape by any accident, such as the sudden movement of the eye away from the knife, in such quantity that the iris falls forward against the cornea, further proceedings should be desisted from, and the operation deferred until the restoration of the aqueous humour, and the subsidence of the reaction, if any, which may have taken place in consequence of the simple puncturation. According to Dr. Desmarres, the aqueous humour may reaccumulate in a few minutes in sufficient quantity to permit the passage of the knife across the anterior chamber, without involving the iris. If the eyeball should roll inwards and upwards so much that the surgeon cannot see the opposite side of the cornea, it is better to withdraw the knife than counter-puncture at hazard. An attempt may be made by the assistant in this case to draw the eyeball downwards by grasping the conjunctiva with a forceps. See above, d. 368.

Protrusion of the iris may take place on the completion of the section, and again after the lens has been extracted. If uncomplicated with escape or protrusion of vitreous humour, the protruded iris is in general readily replaced by means of the curette. After which the upper eyelid is to be drawn down, the finger rubbed over it at the place corresponding to the cornea, and then suddenly raised so as to expose the eye to the light. By this means, contraction of the pupil is excited, and the iris more fully drawn into its place. If the protruding portion of the iris cannot be satisfactorily replaced, it ought to be excised as in iridectomy. The protrusion of the iris, which is apt to occur subsequently, is much more formidable.

Of all the untoward circumstances which may occur in performing the operation of extraction, the protrusion or escape of the vitreous humour in greater or less quantity is assuredly that most to be dreaded. For though it may be promoted by undue pressure on the eyeball, either by the operator or assistant, restlessness of the eye or spasmodic contraction of the muscles of the eyeball at the time of completing the section of the cornea or afterwards, the condition on which it essentially depends is a softened or dissolved state of the vitreous body and its connexions.

When the vitreous body is of its natural consistence, and its connexions unweakened, as in young persons, there is little danger of its escape,—nay, if its escape were desired, it would perhaps not be easy to produce it by any ordinary pressure. To be convinced of this, take the eye of an animal newly slaughtered, make a free section of the cornea, and then try to squeeze out the vitreous humour. It is only when the connexions of the vitreous body have become dissolved by keeping the eye for twenty-four hours or so after death, that the vitreous body can be readily squeezed out. With the advance of age, however, softening of the vitreous body and its connexions, as above observed (p. 282), tends to take place; hence it is that in the operation at present under consideration, viz., extraction of the common hard lenticular cataract of old persons, bursting out of the vitreous humour, with or without the lens, is so apt to occur.

Bursting out of the lens, together with a greater or less quantity of vitreous humour, immediately on completing the section of the cornea.—In this case the operation is completed, and whether it is likely to be followed by a good or bad result will, in a great measure, depend on the quantity of vitreous humour lost. If the quantity does not exceed one-fourth, it is possible for the eye to recover with pretty good vision; if more is lost, such an event is not to be hoped for.

In any case the mode of procedure is to close the eyelids immediately, and after some time, cautiously open them to see how the flap of the cornea lies. If the iris is protruded, an attempt is to be made by the manœuvres above described, to replace it, and bring the edges of the corneal wound together, as far as can be done, preparatory to bandaging the eye. A portion of the hyaloid, however, may protrude, and thus prevent the replacement of the iris and accurate closure of the corneal wound. All that can be done now is to close up the eyelids, and leave things to nature. Under the most favourable circumstances, the wound of the cornea heals slowly, and the pupil is dislocated towards the cicatrice. Still, pretty good vision may be restored.

Vitreous humour may begin to escape without the lens.—In this case the small hook is immediately to be introduced, and the cataract hooked by its lower edge, and brought out as quickly as possible.

If the cataract should sink in the vitreous humour nearly or quite out of sight, a cautious attempt may be made to hook it out, but not persisted in if unsuccessful. In this case it must be left, and the eye closed, otherwise the complete evacuation of the vitreous humour will inevitably take place. In the case of a gentleman on whom I lately operated, the lens sank below the pupil in the act of lacerating the capsule, and vitreous humour began to escape. I immediately, therefore, closed the eye, and on examining it four or five days after, I was pleased to find the pupil clear, good sight restored, and no inflammatory reaction. The sight has continued good to the present time.

Untoward occurrences after the operation.—Though the cataract may have been extracted without accident, and though when the eye is bound up everything appears right, untoward symptoms may yet occur in the course of the following seven days.

Inflammation.—Undue inflammation may occur:—such as corneitis, interfering with the union of the corneal incision and disposing to protrusion of the iris,—or, after the corneal incision has healed, iritis may set in of a rheumatic, or, what is worse, of an arthritic character. But the inflammation most to be dreaded is *Panophthalmitis.*

In phlegmonous panophthalmitis (p. 248), along with severe pain, the eyelids are swollen, red, and tender to the touch, the conjunctiva is in a state of inflammatory chemosis, the edges of the corneal incision are opaque, swollen, and everted, the anterior chamber is filled with pus, and the whole eyeball protrudes from the orbit in a state of disorganization.

A low form of panophthalmitis is apt to occur in old, weakly persons, in which the pain may not be less severe than in the acute, but the swelling of the eyelids is merely œdematous and the chemosis of the conjunctiva serous. The cornea becomes infiltrated with matter, and its destruction by ulceration is imminent. The patient is restless, with the pulse small and feeble.

In corneitis and iritis after extraction, the use of mercury has been dreaded, lest it might check the adhesive process, and thus prevent union of the section of the cornea. Experience, however, shows, that after the operation of extraction, the patient may be put under the use of mercury, without any prejudice to the union of the section of the cornea, but the reverse; for the mercury, reducing inflammation, promotes adhesion.

In the low inflammation which is liable to occur in old and weakly persons, cordials and supporting diet are necessary.

Secondary prolapsus iridis.—It has been above stated that prolapsus iridis is apt to take place at the time of the operation (*primary prolapsus iridis*); but though such has not occurred, the eye is not yet safe from prolapsus iridis, for in the course of the three or four days following the operation, the iris may yet protrude. This secondary prolapsus iridis may be occasioned by the bursting open of the half-healed corneal wound in consequence of some such effort as coughing, but it is generally owing to non-union and retraction of the edges of the corneal incision, with swelling of the iris, occasioned by the supervening inflammation, or by extravasation of blood.

Nothing should, in general, be done directly. If the protruded iris be large, and appear to be much distended by fluid behind, the propriety of puncturing or snipping it off may come to be a question. It is sufficient to snip off the superficial part of the protruded iris, and touch it with the nitrate of silver pencil. This will promote cicatrization. As the inflammation subsides, the protrusion sinks, and the iris will be involved in the cicatrice of the cornea, which will be broad and unsightly, whilst the pupil will be displaced, and may be contracted or altogether closed.

Hæmorrhage.—Among the accidents to be dreaded after the operation of extraction, hæmorrhage is also to be mentioned. Blood is extravasated in the interior of the eye, and may escape externally in greater or less quantity.

This mischance happened to an old gentleman above eighty years of age, on whom I operated. The lens had been extracted successfully and satisfactorily. During the night the patient, feeling a call to stool, got up, and, without thinking of his eye, which was quite easy, made an effort. By this, acute pain in the eye was occasioned at the moment. Next day, to my chagrin, I found blood oozing from the eye, and the iris infiltrated with blood protruding through wound of the cornea.

In cases of penetrating wound at the sclerotico-corneal junction, union is liable to take place only through the medium of a thin membranous substance, which, yielding to the pressure by the aqueous humour, becomes distended in the form of a whitish vesicle. A similar thing is sometimes met with after extraction, in cases in which the section of the cornea has encroached upon the sclerotico-corneal junction at some point.

If the vesicle be punctured, the aqueous humour escapes, and it becomes collapsed; but with the re-accumulation of the aqueous humour it again becomes distended. Even if snipped off, it may again be formed.

I have seen cases in which such a vesicle had existed for years. In one case, it formed after an accidental wound in childhood; in another, after the operation of extraction.

Such vesicles, when they occur after extraction, I have effectually obliterated, by thrusting a pointed nitrate of silver pencil into them, without any previous puncture. The cauterised spot sloughed, the aqueous humour was evacuated, the opening closed, the part became consolidated, and no new protrusion took place, on the re-accumulation of the aqueous humour.

Senile entropium.—This sometimes occurs and may require the operation, collodion seldom answering the purpose. See *infra.*

Advantages and disadvantages of the three different sections of the cornea.—The section downwards is on the whole more easily made than that upwards; the lower half of the cornea in general admitting of being better exposed, and thus more accessible to the knife than the upper half.

When the section of the cornea downwards is completed, the knife is more readily withdrawn, and the upper eyelid can be allowed at once to fall gently down over the flap without disturbing it; whereas, when the section upwards is completed, more nicety is required in withdrawing the knife and letting down the upper eyelid, in order that its border may not catch the flap of the cornea, and turn it down.

When the section downwards has been made, the escape of the lens takes place more easily, and less injuriously to the iris and corneal flap, than when the section upwards has been made, the tendency of the eyeball to roll upwards and inwards being a great impediment to the escape of the lens in the latter case.

Escape of vitreous humour, it has been thought, takes place more readily, when the section is downwards than when it is upwards, in consequence of the operation of gravity, but such is not the case. It has been above seen that this accident is owing to the vitreous body being in a dissolved state, and thus readily squeezed out by the elastic reaction of the coats of the eye as well as the spasmodic action of the muscles of the eyeball, an effect which is produced in whatever direction the section may be made, and whether the patient be lying horizontally or seated upright.

Nor is prolapsus iridis more prone to take place when the section is downwards than when it is upwards; but if it does take place when the section is downwards, the bad cicatrice which results is more readily seen, interferes more with vision, and if the pupil be closed, an artificial pupil cannot be made in so advantageous a situation afterwards. The contrary of all this is the case when the section is upwards; a bad cicatrice from protrusion of the iris and vitreous body is not seen, nor does it interfere with vision, and, supposing the pupil closed, the eye is in a better state for artificial pupil.

On the other hand, the pupil, though drawn towards the incision, may be of good size. In such a case, it is more useful when situated next the lower margin than when it is next the upper margin of the cornea.

The flap of the cornea when the section is upwards, is kept in good apposition by the upper eyelid, whereas when the section is downwards, the tarsal border of the lower eyelid is liable to displace the edges of the corneal flap, and so give rise to inflammation, prolapse of the iris, &c. This may, however, be obviated by care.

The section downwards and outwards shares in the advantages and disadvantages of the other two sections.

2nd.—*Extraction through a semicircular flap-incision of the cornea, with iridectomy.*

When, in making the flap-section of the cornea, the iris falls against the edge of the knife and a piece of it is cut out (p. 371), the success of the operation is not compromised, but the case usually turns out as favourably as when the iris has not been implicated, or even more so. The only disadvantage is the misshapen and large pupil, though when the section has been upwards, that is not of much consequence, either as regards appearance or the vision.

We need, therefore, not be anxious to avoid excising a bit of the iris; but ought we to perform iridectomy intentionally?

There can be no doubt of the propriety of cutting off a bit of the iris if it protrudes, and on being replaced, tends to protrude again. There can also be no doubt of the propriety of excising a bit of the iris, if it has suffered much bruising during the act of extracting the cataract, either in consequence of unyielding rigidity of the pupil, or in consequence of the section of the cornea having turned out too small or, with a good-sized section, in consequence of the lens being hard to its very surface.

After iridectomy under such circumstance, there is less liability to the supervention of iritis, and perhaps also to suppuration of the cornea.

As iridectomy at the time of the extraction is not so easy or safe as when it is performed in the ordinary way (p. 151), it has been recommended by Dr. Mooren and others, to excise the bit of iris as a regular preliminary to the operation of extraction a month or so before the latter.

Iridectomy, as a preliminary to extraction by a semicircular flap-section of the cornea, may be had recourse to in such cases as the following:—

1. When the pupil does not yield well to the influence of atropia, though the case appears otherwise a fit one for extraction.
2. When the iris is inclined towards the cornea, so that the anterior chamber is too small to permit the passage of the knife without implicating the iris.
3. In extensive synechia posterior. In such a case it is best to perform the iridectomy on the side where the adhesions are most likely to interfere with the free exit of the lens.
4. When the cataract appears to be large and hard to the very surface.

3rd.—*Extraction through a puncture-section of the cornea.*[*]

Through a small section of the cornea, we may extract soft cataracts, fluid cataracts, siliquose cataracts, and capsular cataracts. Also the opaque lenticular substance in cases of rupture of the capsule from injury, and in which the protruding opaque lenticular substance presses on the iris and causes inflammation of it.

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[*] Linear extraction.

Method of making the puncture-section.—The pupil being dilated, we puncture the cornea on the temporal side, with the keratome or lancet-shaped knife (Fig. 84), about one-tenth of an inch from the sclerotica, and push the instrument on through the anterior chamber towards the nasal side, until it has by its increase in breadth made an incision of the cornea about three-tenths of an inch in vertical length (Fig. 85). We then slowly withdraw the instrument.

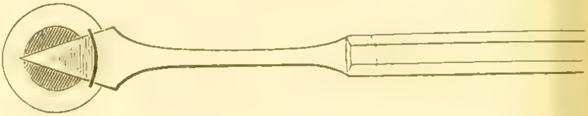

FIG. 85.

The remaining steps vary according to the nature of the cataract to be extracted.

4th.—*Extraction of fluid and soft lenticular cataracts through a puncture-section of the cornea.*

About the beginning of this century, Mr. Gibson of Manchester, practised the extraction of soft cataracts through a small incision of the cornea. He first of all freely lacerated the anterior wall of the capsule with a cataract needle introduced through the sclerotica, and after two or three weeks, proceeded to extract the pulpy lens. For this purpose, he punctured the cornea, near its temporal edge with a broad extraction knife. On withdrawing the instrument, part of the aqueous humour and some portion of the cataract were evacuated. The curette was next introduced through the incision towards the pupil; and by that instrument, the whole of the cataract was removed by degrees, and the pupil rendered perfectly clear. Its removal was generally

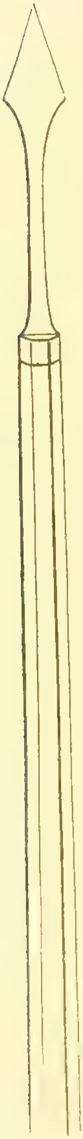

FIG. 84.

much facilitated by gentle pressure, towards the vitreous humour, with the convex surface of the curette, whilst the point of the instrument was inserted through the pupil.

This operation was modified and simplified by the late Mr. Travers, in the following manner:—Instead of opening the capsule with the needle passed through the sclerotica, and then waiting for two or three weeks, he began by making a quarter-section of the cornea, dipping the point of the knife into the pupil, which had been previously dilated by belladonna, and freely dividing the capsule. This being done, the cataract, if fluid, was instantly evacuated along with the aqueous humour; if flocculent, it took an oblong shape and frequently passed out entire. The caseous cataract was extracted piecemeal along the hollow of the scoop, on gently depressing the margin of the pupil.

If the operator limits the first step of the operation to making the puncture-section of the cornea, he makes the laceration of the capsule the second step. This comprises the introduction of the sickle-shaped needle (Fig. 91, p. 398) through the corneal wound, in order to make a free incision of the capsule with it in a horizontal direction across.

If the cataract be fluid, it is evacuated; if soft it may only partially protrude. Its complete extraction then constitutes the third step.

Daviel's curette is passed a little within the corneal incision, with its convexity next the posterior lip, against which it is made to press so as to cause the opening to gape. At the same time that he does this, the operator makes gentle pressure with his finger on the eyeball next the nasal margin of the cornea, and in a direction towards the centre of the pupil, in order to push the cataract towards the opening in the cornea.

If by this manœuvre the cataract is not completely evacuated, it will be necessary to enter the curette into the aqueous chamber, and scoop out the remains of the cataract.

If, as is sometimes the case, the capsule is the seat of opaque deposits, it is to be extracted by means of the cannula forceps, or tooth-pointed forceps, or simple hook as described in the next article.

5th.—*Extraction of siliquose and secondary capsular cataracts through a puncture-section of the cornea.*

As a preparatory step in this case, it is advisable to detach the cataract from its connections by means of the sickle-shaped cataract needle (or the cannula scissors, as explained below) introduced through the sclerotica.

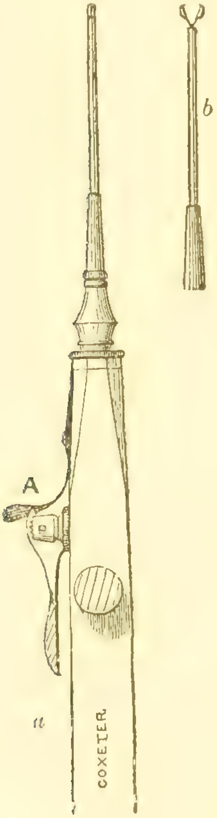

Fig. 86.

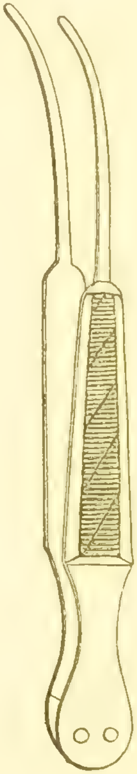

Fig. 87.

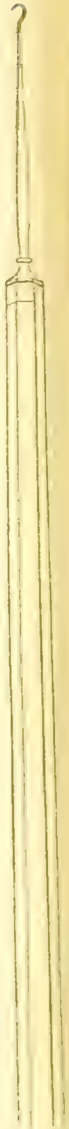

Fig. 88.

This being done, the puncture-section of the cornea is next made. The cannula forceps (Fig. 86), the slender-bladed tooth-pointed forceps (Fig. 87), or a simple hook (Fig. 88), is then introduced, the cataract seized, cautiously detached from any remaining connections by gentle twitches, and extracted.

The cannula forceps is managed thus :—Being closed (Fig. 86 *a*), by keeping the trigger pressed down, its point is introduced through the incision of the cornea to the pupil. By now suspending the pressure on the trigger, the forceps is opened (Fig. 86 *b*), when the cataract is to be laid hold of by again pressing down the trigger.

The cannula forceps is also useful for seizing hold of and dragging out the iris for excision.

Mr. Coxeter has made a useful addition to the cannula forceps, consisting of a small spring, which catches the ordinary trigger (Fig. 86 A) after it has been depressed, in order to keep the forceps closed, and thus leave the operator's hand and fingers free to execute any twitches or other manœuvres that may be necessary for the detachment of the cataract. As the trigger is again released by very slight upward pressure of the same finger that is used when the ordinary instrument is employed, it can scarcely be said that the addition of the spring under notice complicates matters, while its effect is to keep the blades of the forceps perfectly closed.

The mechanism of the cannula forceps has been applied, by Sir William Wilde, of Dublin, to the working of a minute pair of scissors. In Fig. 89 *a* the scissors are represented closed ready for introduction, and in

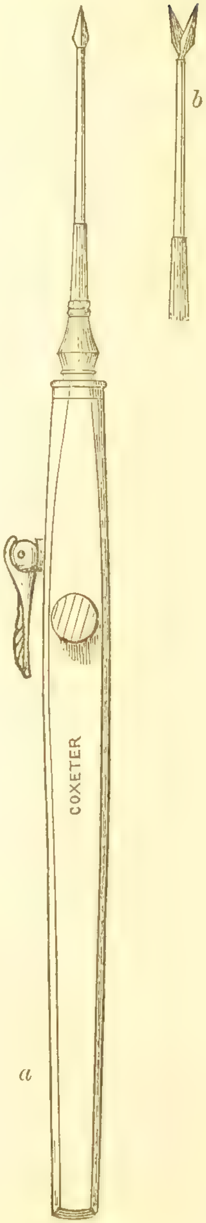

Fig. 89.

the same figure, *b*, open, ready for cutting, by pressing down the trigger. When closed, the scissors are pointed, like a lance-shaped cataract needle, and in this state are capable of piercing the sclerotica or cornea, though it is better to make a preparatory puncture with an ordinary cataract needle.

The cannula scissors are useful for cutting through bands of tough opaque capsule or false membrane, preparatory to extraction. The scissors are also found of great use for incising the iris in certain of the operations for artificial pupil.

6th.—*Extraction through a puncture-section of the cornea, with iridectomy.*

Iridectomy facilitates the extraction through a small section of the cornea of cataract with small hard nucleus, &c.

When iridectomy is to be at the same time performed, the puncture-section of the cornea should be made nearer the sclerotica than is above directed (p. 390).

Dr. Schuft, with his curette, broader than Daviel's, has through such a section scooped out hard nuclei, traumatic cataract with a foreign body imbedded in it, and also natatile cataracts.

7th.—*Extraction of siliquose and secondary capsular cataracts through a puncture of the sclerotica.*

Siliquose and secondary capsular cataracts may often be advantageously extracted through a puncture of the sclerotica and pars non-plicata of the ciliary body at the place of puncture usual in needle operations. The connections of the cataract are in the first place to be divided by the sickle-pointed cataract needle or cannula scissors introduced by puncture through the sclerotica as above directed. The puncture is next to be enlarged to the necessary extent, and then the cataract extracted by means of the cannula forceps, as directed for extraction through the cornea (Fig. 90).

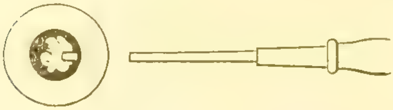

FIG. 90.

DIVISION OF THE CATARACT.

The object of this operation is to lacerate the capsule, and divide the lens, so that the latter may be gradually dissolved and absorbed, and thus ultimately altogether removed from the eye.

Considered as an operation, division is the most simple of all those for cataract, both in performance and in the extent of injury necessarily inflicted on the eye.

Indications.—Division is indicated in:—Soft or fluid cataracts especially—the cataracts of most common occurrence in early life; but it is also applicable to firm cataracts without a hard nucleus, such as are met with in persons about and below fifty years of age. It is the operation also for *congenital cataract*. See below.

Prognosis.—In the cases proper for the operation, the prognosis is good, but though the lens may be perfectly absorbed, the capsule, which does not admit of solution and absorption, if not already opaque, may become so, and form what is called *secondary capsular cataract*. To anticipate this, the capsule should be as completely cut up as possible at the part corresponding to the pupil. The rapidity with which solution and absorption go on, varies from a few days to several months. In general it may be said that in children the absorption proceeds more quickly than in adults.

One operation may suffice, but generally, solution proceeding slowly, the operation requires to be repeated, and that more than once. This, as the operation is so simple and painless, is no great objection. The interval between the repetitions of the operations should be about six weeks.

It is best to operate on both eyes at the same time. I have observed that solution proceeds more quickly after the operation on both eyes at the same time, than after the operation on one eye only.

If the retina was previously quite sound, a perfect restoration of vision may be calculated on, if solution and absorption go on pretty quickly; if not, by the time the cataract disappears, the sensibility of the retina may be found impaired.

The operation of division may be performed either by sclerotic puncturation, or by corneal puncturation.

On repeating the operation of division, it is usually found that the lenticular substance has become more brittle and more easily broken up into fragments than at the first operation. In caseous cataract, the tenaciousness is still encountered.

Treatment and accidents after division.—After the operation, the pupil is to be kept under the influence of belladonna.

Iritis is liable to supervene, and when corneal puncturation has been performed, corneitis and aquo-capsulitis are not uncommon.

For the treatment of those inflammations, see above (p. 213).

1st.—*Division of the cataract by sclerotic puncturation.*

The instrument best adapted for this operation is a curved lance-shaped or a sickle-shaped needle. The pupil should be well dilated, and the patient, assistant, and operator placed as above recommended (p. 359).

For the convenience of description, the operation may be supposed to be divided into different steps.

The *first step* comprehends *puncturation* of the sclerotica, about three-twentieths of an inch from the temporal margin of the cornea, and in the line of its transverse diameter.*

The *second step* comprehends the laceration of the posterior wall of the capsule and division of the lens from behind.

Method of holding the cataract needle.—The handle of the needle is to be held between the fore and middle-finger on the one side, and the thumb on the other, much i the same way as above recommended for the catarac knife.

Puncturation.—The surgeon thus holding the needle and resting his hand by the little finger on the patient cheek, disposes it in such a way, that the blade of th eedle is close in front of the cornea, in a line, corresponding to the transverse diameter of the latter, and its oint extending to opposite the nasal margin of the ilated pupil. He now prepares for puncturation, by etracting the fingers holding the needle, and slightly urning the hand, so that the point of the instrument ay be presented to the point of the sclerotica, where uncturation is to be made.

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* The direction to introduce the needle either above or below th transverse diameter of the eye is that which is most generally given and the reason assigned for it is, that the long ciliary artery rur in the line of the transverse diameter; but as at about a quarte of an inch from the iris the long ciliary artery of the temporal sid divides at an acute angle into two branches, an upper and a lowe it is obvious that the artery cannot be touched, and the sure way to avoid the branches is, to enter the needle as above recommended.

When a curved needle is used, its convexity should ook upwards, and its concavity downwards in making he puncture; and in order that the point may be applied erpendicularly to the place to be punctured, it is necessary to depress the handle of the instrument; but of ourse, in proportion as the instrument penetrates, the andle is raised to the horizontal.

Laceration of the posterior wall of the capsule.—Puncturation being accomplished, the head of the needle, with ts cutting edges upwards and downwards—if a curved eedle, the concave surface of course forwards,—is to be irected against the posterior wall of the capsule, and ade to lacerate it freely, and to divide the substance of he posterior strata of the lens by rotatory movements of he handle of the instrument.

The withdrawing of the needle from the eye is effected by series of manœuvres, exactly the converse of those performed in introducing it, as above described.

This is especially to be attended to, when its head comes o the puncture in the coats; here it is to be so rotated, hat the surfaces shall be above and below as at the introduction of it, and then it is to be drawn out at right ngles to the surface of the sclerotica, for which purpose, hen the needle is curved, its handle must be depressed n proportion as the head is withdrawn.

After the operation just described, there is in general ttle reaction.

In consequence of the laceration of the posterior wall f the capsule and the necessary laceration at the same ime of the hyaloid with which the posterior wall is in onnection, vitreous humour obtains access to the lenticular substance. The effect of this is that the lens ecomes still more opaque than before, swells up, and is ventually so far absorbed as to be reduced to a thin and rittle cake behind the anterior wall of the capsule which will be observed has been left still entire.

In this proceeding, though the lens, covered by the

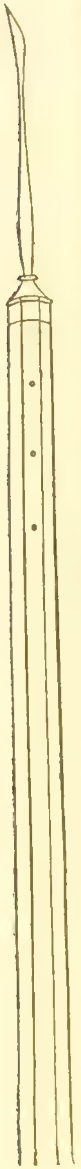

FIG. 91.

anterior wall of its capsule, may be, in consequence of the swelling up of the divided posterior strata, pushed against the iris, the pressure on the latter is uniform, and does not irritate it in the same degree as the irregular pressure produced by the swollen lens, when the operation by dividing the anterior wall of the capsule first is performed.

At the end of a month or six weeks the operation is to be repeated, but this time it is the anterior wall of the capsule that is to be lacerated, and the anterior part of what remains of the lens which is to be divided.

In this case the *first step* comprehends the puncturation. The *second step*, the introduction of the needle into the posterior chamber, so that its lance head is seen through the pupil. The *third step*, the laceration of the anterior wall of the capsule and the division of the lens.

The introduction of the needle into the posterior chamber in this case is more simple than when the anterior wall of the capsule is lacerated in the first operation, as described below.

The anterior wall of the capsule is lacerated, by directing the point of the curved lance-head of the needle against it, and by slight rotatory movements of the handle of the instrument making several vertical incisions in the part of it corresponding to the pupil. The capsule is then to be divided horizontally, by pressing one of the edges of the needle against it, which is done by slightly moving the handle of the instrument forwards.

If it is the sickle-shaped needle (Fig. 91) that is used, it is best to direct its concave cutting edge against the capsule and divide it horizontally first; then, by a rotatory movement of the instrument, to tear it in a vertical direction—from the circumference above and from the circumference below towards the horizontal incision.

In using the sickle-shaped needle, puncturation is made by directing its point, with the convex cutting edge looking to, and the concave cutting edge from, the cornea, the flat surfaces upwards and downwards, perpendicularly to the surface of the sclerotica, and steadily thrusting it in in a direction towards the centre of the eyeball, but no deeper than until the sickle head of the instrument disappears. The handle is then inclined back towards the temple, and so rotated that the edges of the needle may be directed upwards and downwards preparatory to its being pushed on into the posterior chamber.

Division of the lens.—Having thus freely divided the capsule, the surgeon turns the sharp point of the needle against the lens opposite the pupil, and by slight rotatory movements of the handle of the instrument, breaks up its substance.

If at the end of six weeks or two months the pupil has not begun to clear, it will be necessary to repeat the operation a second time. In such a repetition, the further division of the lens from the front is all that is required.

From this mode of operating, I have obtained excellent results, even in persons above fifty years of age. In such persons, the cataracts which are white and firm, are often accompanied by a dissolved state of the vitreous humour rendering extraction dangerous.

As the loss of a small quantity of the dissolved vitreous humour at the time of the operation, diminishes the risk of inflammation, I use a very broad needle in order that, through the large puncture, issue may be given to a few drops of that fluid.

As generally performed, the operation does not comprehend laceration of the posterior wall of the capsule and division of the lens from behind, but simply laceration of the anterior wall of the capsule and division of the lens from the front.

In this mode of operating the steps are:—1st. Puncturation. 2nd. Introduction of the needle into the posterior chamber, so that its lance-head is seen through the pupil. 3rd. Laceration of the anterior wall of the capsule and division of the lens from the front, if a first operation on the eye; if it be a repetition of an operation, he further division of the lens is all that is required.

Puncturation of the sclerotica is performed in the manner above described.

Introduction of the needle into the posterior chamber, so hat its head is seen through the pupil.—The surgeon assuring himself by the marks on the handle, that the edges of the sickle-head are directed upwards and downwards; or, if the needle be a curved one, that the convexity of the curve is forwards, and the concavity backwards, inclines the handle of the instrument well back towards the temple of the patient, and proceeds to push its point into the posterior chamber, where it will be seen through the pupil with one surface looking forwards, the other towards the cataract, and its edges upwards and downwards (Fig. 92).

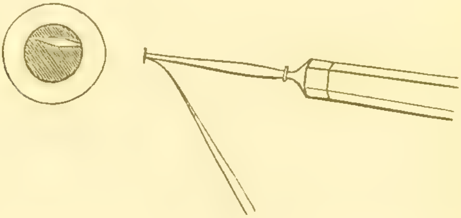

FIG. 92.

In this step the needle necessarily passes through the temporal border of the crystalline lens and capsule. But care should be taken not to spit the firm nuclear part of the lens on the one hand, or the ciliary body on the other. If this should occur, the needle ought to be a little withdrawn, to get its point free again, before pushing it on. In entering the posterior chamber, the point of the needle is apt to spit the iris, especially if the needle be a straight one. The remedy for this also, is to withdraw the instrument, until its point gets free, when it may again be pushed on. The importance of having the point of the needle free is evident. Again, the point of the needle may be made to project too much through the pupil, and spit the inner surface of cornea.

Laceration of the anterior wall of the capsule and division of the cataract.—In the last step, the head of the needle appeared in the posterior chamber, by piercing the anterior wall of the capsule from behind. Such movements are now to be executed with the point of the needle as are calculated to ensure the free laceration of the anterior wall of the capsule both vertically and horizontally, as above directed.

It is to be remembered, that it is better not to risk reaction by attempting too much at one time, in the way of breaking up the lens, but the capsule ought always to be freely lacerated at first. Especial care should be taken not to displace the whole lens, or even any considerable piece of it unbroken up.

2nd.—*Division of the cataract by corneal puncturation.*

The instrument with which the performance of this operation is most simple, is a straight needle, ground flat on the sides towards the point, so that as it penetrates the cornea, it fills completely the puncture, though not in a forced manner, and thus prevents the escape of aqueous humour.

This is an important point, for if evacuation of the aqueous humour takes place, the iris and lens fall forward and the pupil contracts so that the manipulations of the operation are interfered with.

Preparatory to the operation, the pupil should be well dilated by belladonna.

First step.—This comprehends the puncturation and the advance of the point of the needle through the dilated pupil towards the cataract.

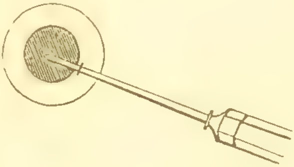

FIG. 93.

The point of the cornea where the needle is to be made to pierce, is about half-way between its centre and its outer and lower margin.

The flat surfaces of the needle being—the one towards the centre of the cornea, the other towards the margin, he point of the instrument is directed perpendicularly to the place above indicated, when it is to be made to pierce by a quick thrust, executed solely by the movements of the fingers. Having thus pierced the cornea, the handle of the instrument is depressed, and its point steadily pushed on towards the cataract, still by the movements of the fingers.

Second step.—This comprehends the laceration of the anterior capsule if a first operation, or the breaking up of the lens if a repetition.

One of the edges of the instrument being directed against the capsule, one or more incisions are to be made in it from above and outwards, downwards and inwards, by a lever-movement of the handle of the needle.

The division of the lens is effected so far as is proper, by similar incisions.

Withdrawing of the needle from the eye.—In doing this, the surfaces of the instrument are to be directed in the same way as when it was introduced.

3rd.—*Division of the cataract combined with iridectomy.*

Iridectomy has of late been performed by some operators as a preliminary to division in cases of soft cataract complicated with synechia posterior, in which there has been reason to anticipate much pressure on the iris by the swelling of the lens after the division, or the like.

The excision ought to be above.

DISPLACEMENT OF THE CATARACT AND ITS MODIFICATIONS.

There are two modifications of the operation of displacement, viz., *couching* or *simple depression*, and *reclination*. In the one case the displaced lens has its anterior surface downwards and somewhat forwards,—its posterior surface upwards and somewhat backwards,—its superior edge forwards and somewhat upwards,—its lower backwards and somewhat downwards, thus:—

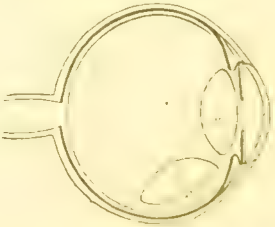

FIG. 94.

In the other case, the displaced lens has, at the same time that it was depressed, been made to turn back on its lower and outer margin, so that, its upper edge being forced back into the vitreous humour, its anterior surface comes to be uppermost, its posterior surface directed downwards, thus:—

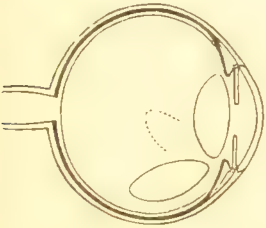

FIG. 95.

Both couching and reclination of the cataract may be effected by introducing the cataract-needle, either through the sclerotica, that is, by *sclerotic puncturation* (*scleroticonyxis*), or through the cornea, that is, by *corneal puncturation* (*keratonyxis*).

Reclination effecting all that couching can, and being in every respect a better operation, couching has altogether fallen into disuse. It is, therefore, unnecessary to say more about it here.

Indications for the operation of displacement.—The kind of cataract best fitted for displacement is the same as that best fitted for extraction. Whether or not, therefore, displacement should be performed instead of extraction, will depend upon the absence of the conditions necessary for or at least favourable

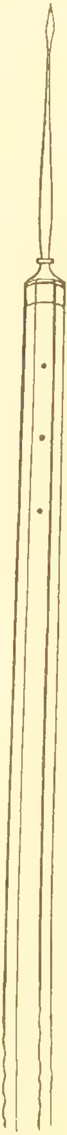

FIG. 96.

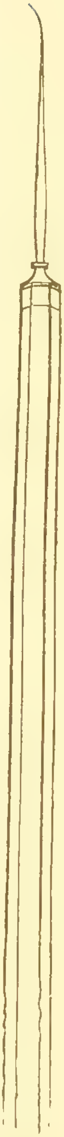

FIG. 97.

to the successful performance of extraction (p. 363), or the existence of the conditions unfavourable to or wholly forbidding it (p. 363).

Prognosis.—The displaced lens, if disengaged from its capsule, may eventually disappear, or be reduced to a small size, by solution and absorption, especially in persons of less advanced age—say about fifty,—and when the cataract is not very hard. But in such a case we have seen that division would be the better operation. In many cases, however, it does not dissolve, and is always apt to rise again. The success of displacement is liable to be marred by posterior internal inflammation, either of an acute character, supervening immediately on the operation, or of a slow destructive character, coming on some time subsequently, and leading to loss of sensibility of the retina.

Instrument and dressing.—The only instrument required is a lance-shaped cataract-needle, either straight or curved. (Figs. 96, 97.) The dressings are the same as above mentioned for extraction.

1st.—*Reclination by sclerotic puncturation.*

For the convenience of description, the operation may be supposed to be divided into different steps.

The first step comprehends puncturation. The point of puncturation should be about three-twentieths of an inch from the temporal margin of the cornea, and in the line of its transverse diameter, as above directed for division by sclerotic puncturation.

The second step comprehends laceration of the posterior wall of the capsule, and corresponding part of the vitreous body.

The third step comprehends the introduction of the needle into the posterior chamber, so that its lance head is seen through the pupil.

The fourth step, laceration of the anterior wall of the capsule, and the reclination of the cataract.

The pupils of the patient should be well dilated preparatory to the operation.

The position of the patient, assistant, and operator, is arranged as above recommended (p. 359, et seq.).

Method of holding the cataract-needle.—The handle of the instrument is to be held between the fore and middle fingers on the one side, and the thumb on the other.

much in the same way as above recommended for the cataract-knife.

Puncturation.—The surgeon thus holding the needle, and resting his hand by the little finger on the patient's cheek, disposes it in such a way, that the blade of the needle is close in front of the cornea, in a line, corresponding to the transverse diameter of the latter, and its point extending to opposite the nasal margin of the dilated pupil. He now prepares for puncturation, by retracting the fingers holding the needle, and slightly turning the hand, so that the point of the instrument may be presented to the point of the sclerotica, where puncturation is to be made.

If it be a straight needle that is used, its point, with the cutting edges looking to and from the cornea, the flat surfaces upwards and downwards, is directed perpendicularly to the surface of the eyeball at the place above mentioned, and steadily thrust in in a direction towards the centre of the eyeball, but no deeper than until the lance head of the instrument disappears.

When a curved needle is used, its convexity should look upwards, and its concavity downwards in making the puncture; and in order that the point may be applied perpendicularly to the place to be punctured, it is necessary to depress the handle of the instrument; but of course, in proportion as the instrument penetrates, the handle is raised to the horizontal.

Laceration of the posterior wall of the capsule, and breach in the vitreous body for the reception of the lens.—Puncturation being accomplished, the head of the needle, with its cutting edges upwards and downwards—if a curved needle, the concave surface of course forwards,—is to be directed against the posterior wall of the capsule, and made to lacerate it vertically, and the vitreous body behind and below it, to the necessary extent.

Introduction of the needle into the posterior chamber, so that its lance head is seen through the pupil.

Having lacerated the posterior wall of the capsule, and made a breach in the vitreous humour for the reception of the lens, the surgeon, withdrawing the instrument now so far that its neck comes again to correspond to the point of puncture, as it did when first introduced, and assuring himself by the marks on the handle, that the edges of the lance head are directed upwards and downwards; and, if the needle be a curved one, that the convexity of the curve is forwards, and the concavity backwards, inclines the handle of the instrument well back towards the temple of the patient, and proceeds to push its lance head into the posterior chamber, where it will be seen through the pupil with one surface looking forward, the other towards the cataract, and its edges upwards and downwards. Fig. 98.

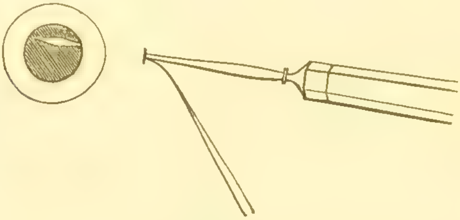

FIG. 98.

In this step the needle necessarily passes through the temporal border of the crystalline lens and capsule. But care should be taken not to spit the firm nuclear part of the lens on the one hand, or the ciliary body on the other. If this should occur, the needle ought to be a little withdrawn, to get its point free again, before pushing it on. In entering the posterior chamber, the point of the needle is apt to spit the iris, especially if the needle be a straight one. The remedy for this, also, is to withdraw the instrument, until its point gets free, when it may again be pushed on. The importance of having the point of the needle free is evident. Again, the point of the needle may be made to project through the pupil, and spit the inner surface of the cornea.

Reclination and laceration of the anterior wall of the capsule of the cataract.—In the last step, the lance head of the needle appeared in the posterior chamber, by piercing the circumferential part of the lens and anterior wall of the capsule from behind.

Being sure that the point of the needle is free from entanglement, the surgeon now applies its lance head flat against the lens, a little above its transverse diameter (if the needle is a curved one, it is by its concave surface that its lance head is to be applied to the lens), and then by moving the handle of the instrument gently forwards a little, he presses back the upper part of the lens. When the upper part of the lens has yielded to this backward pressure, he rotates the needle slightly to keep it flat on the surface of the lens, and then presses the latter downwards, backwards, and outwards, by gently raising the handle of the instrument upwards, forwards, and inwards. In this act the anterior wall of the capsule is necessarily rent across.

If the needle used is a curved one, it will be necessary, in order to complete the depression, to apply the convexity of its lance head to the cataract. This is done, by depressing the handle a very little, so as to lift the lance head from off the cataract, and then rotating it one-half round its axis.

Withdrawing of the needle from the eye.—Having, for half a minute or so, kept the point of the instrument resting on the depressed cataract to prevent it from rising, the surgeon now lifts it slowly from off the cataract, by lowering the handle. Seeing that the cataract does not rise, he brings the head of the instrument back into the posterior chamber, by moving the handle a little backwards. Here the surgeon still retains the instrument within the eye for half a minute longer, and makes such movements of its head as are calculated to lacerate what of the anterior wall of the capsule may remain opposite the pupil. The cataract remaining depressed, the needle may now be withdrawn from the eye, by a series of manœuvres exactly the converse of those performed in introducing it. This is especially to be attended to, when its head comes to the puncture in the coats; here it is to be so rotated, that the surfaces shall be above and below as at the introduction of it, and then it is to be drawn out at right angles to the surface of the sclerotica, for which purpose, when the needle is curved, its handle must be depressed in proportion as the head is withdrawn.

If instead of being hard, as was supposed, the cataract should be found friable, breaking under the needle, reclination ought not of course to be persisted in, but the lens left to be dissolved and absorbed; in short, division s to be substituted for reclination. Sometimes the exterior strata of the lens are soft and the nucleus hard; n this case the latter should be reclined and the former divided.

Reclination as now described, is in general readily effected in the common lenticular cataract of old people; but sometimes the cataract rises as soon as the point of the needle is withdrawn from it, and this over and over again. Such a cataract has been called *elastic cataract.*

The cause of the elastic re-ascension of the cataract is, I am disposed to believe, that in such cases the vitreous body still possesses its natural consistence, and therefore resists the sinking of the lens into its substance, as every one who has been accustomed to dissect healthy eyes, knows the vitreous body will do.

A persistence in attempts at displacement in such a case, would prove extremely detrimental to the internal structure of the eye. The attempt, therefore, ought not to be repeated, until the posterior wall of the capsule has been again lacerated, and a freer breach made in the vitreous body, for the reception of the reclined lens.

I would however remark, that when the vitreous body is of such firm consistence as to resist the lens being forced into its substance, extraction of the cataract would be a much better and safer operation, if there existed no particular indication of any weight against it.

The lens may, instead of going down under the needle, suddenly burst through the pupil into the anterior chamber. In such a case, if it appears that it was on account of the firmness of the vitreous body that the lens did not yield to the needle, the surgeon should immediately proceed to extraction; but if it appears that the vitreous body is dissolved, the connexions of the lens weakened, and that on these accounts it was that the lens slipt into the anterior chamber, it would be safer practice, instead of extracting, to endeavour with the needle to bring the cataract back through the pupil, and to depress it.

If extraction be had recourse to, it will be sufficient to make a section of one-third only of the circumference of the cornea. This being done, a hook is introduced, the lens laid hold of, and extracted.

2nd.—*Reclination by corneal puncturation.*

The instrument for this operation is the curved cataract needle.

The pupil should be well dilated, preparatory to the operation, and the position of the patient, assistant, and operator, arranged as above recommended (p. 359, et seq.).

The needle is held between the thumb on the one side, and the fore and middle finger on the other. The side of the handle on which the thumb is, corresponds to the convexity of the instrument; that on which the fore and middle fingers are to the concavity.

The first step comprehends the puncturation, the advance of the point of the needle through the dilated pupil, towards the cataract, and the application of the convexity of the needle against the upper part of the anterior surface of the cataract.

The second step is the reclination of the cataract.

The third step is the withdrawing of the needle from the eye.

Puncturation, &c.—The point of the cornea where puncturation is made, is about one-twentieth of an inch below its centre.

Holding the needle as above directed, the operator directs the lance head of it towards the place of puncturation in such a way that the convexity of the curve is downwards, the concavity upwards, the extreme point perpendicular. The handle of the needle must therefore be directed upwards. Fig. 99.

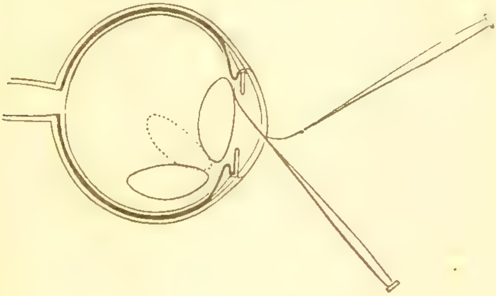

Fig. 99.

When the eye is in a proper position, the operator ierces the cornea perpendicularly, with a quick but teady thrust, executed solely by the movements of the humb and fingers holding the instrument. When the ance head of the needle has penetrated as far as the iddle of its curve, the handle of the needle is to be radually depressed towards the cheek, the puncturation ompleted, and the needle pushed on through the pupil, ith the point upwards, and convexity of its curve towards the upper part of the cataract behind the upper part of the iris. Fig. 99.

Reclination of the cataract.—Having applied the convexity of the needle against the upper part of the anterior surface of the cataract, and right in the middle line, the operator raises, gently at first, the handle of the instrument. The instrument acting as a lever, the fulcrum being the point of puncturation in the cornea, the point of the needle is by this movement made to press back the upper part of the cataract.

When the operator sees that the upper part of the cataract yields, he continues to raise the handle of the instrument firmly and steadily, thus turning the cataract before the needle downwards and backwards, and sinking it in the vitreous humour.

Having kept the point of the needle for half a minute or so resting on the reclined lens to prevent it from rising, the surgeon now slowly withdraws it a little, still keeping the handle elevated, and watches for another half minute whether or not it is disposed to rise again. If not, he continues to withdraw the needle still in the same direction until it is quite free of the cataract and the vitreous humour immediately surrounding, when he depresses the handle, and then brings its point again into the pupil.

Withdrawing of the needle.—The cataract not rising, the needle, after another pause, is finally withdrawn from the eye. And this is done by drawing it out in a horizontal direction, until the middle of the curved head becomes engaged in the puncture of the cornea, when the handle is to be raised, so that the extreme point may be withdrawn at right angles to the place of puncturation, as it was introduced.

In this operation, care is to be taken that the pupillary margin of the iris is not caught by the needle, and during the reclination, that the lower pupillary margin of the iris be not pressed on.

In elastic re-ascension of the cataract, attempts at reclination should not be persisted in, but the plan of operation relinquished. In this case, laceration of the vitreous body and posterior capsule cannot be effected, as it can in reclination by sclerotic puncturation.

Reclination by corneal puncturation has not been found to answer so well as that by sclerotic puncturation, and therefore has never come into use.

Treatment after reclination.—The light fold of linen

(p. 381), to hang over both eyes, is sufficient bandage. In other respects the same general management is to be adopted as above recommended after extraction.

Accidents attendant on the operation of reclination.—In the course of a few hours after the operation, vomiting sometimes occurs.

Acute internal inflammation of the eye is apt to be excited by the operation. Most frequently, however, the supervening inflammation is of a chronic character, ending in disorganization of the eye and loss of vision. The inflammation appears to be at first posterior internal, with exudation on the surface of the retina, and into the vitreous humour, but by-and-by extending to the anterior segment of the eye. It commences from four to eight days after the operation. When the operation is performed by corneal puncturation, corneitis and iritis are apt to be excited primarily.

And after all, re-ascension of the lens is prone to take place.

In the French edition of this work, it is stated (p. 430) that, according to M. Magne, the application of ice over the eye immediately after the operation and continued uninterruptedly for three days prevents any consecutive inflammation; it contributes to the restoration of vision after displacement much better than any other of the medications commonly employed.

3rd.—*Displacement of siliquose and secondary capsular cataract.*

If there is reason to suppose that the vitreous humour is in a fluid state, and that it would therefore be dangerous to attempt extraction either through the cornea or sclerotica, displacement is the operation to be had recourse to.

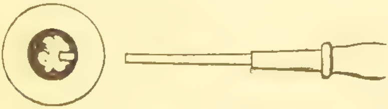

FIG. 100.

This is best effected by means of the cannula forceps, through the small puncture of the sclerotica made by the sickle-shaped needle which is first introduced for the purpose of detaching, at the nasal side, the connections of the opaque capsule or siliquose cataract. Being thus so far detached, the opaque body is seized with the cannula forceps and displaced to behind the temporal half of the iris.

Cataract in infants and children.

Whether the central cataract, which we sometimes discover after the subsidence of the ophthalmia of new-born infants, existed at birth, or came on during the inflammation, cannot always be with certainty determined, for want of previous accurate examination of the eyes at birth. There is, however, no doubt that the infant, at birth, is sometimes affected with cataract; and it is probable that in many of the cases of cataract first noticed in infancy and childhood, the opacity had already existed, though in a less degree, at birth.

In an infant, congenitally affected with cataract, the opacity may be so slight as not to be noticeable to ordinary observation. That there is anything the matter with the sight is first discovered only by the child, as it grows up, holding objects very near to look at them. The defect is accordingly put down as short-sightedness (p. 69). In such a case the surgeon, on examination, discovers a greyish opacity of the lens, either throughout its whole substance or only in its central nucleus, the circumferential part being as yet quite transparent.

Congenital cataract appears to be owing to an original imperfect formation of the crystalline lens; and, as in cases of congenital malformation of other parts of the eye and of other organs, several children of the same parents are sometimes found affected with it.

Though the occurrence of the disease in one child may make us dread lest the children of subsequent births be similarly afflicted, it is quite beyond our power to interpose any special means of prevention.

Of course, every attention should be paid to the mother's health during her pregnancy, and her mind should be, as much as possible, diverted from brooding over the idea that the infant she is carrying may be also born blind from cataract.

In children affected with lenticular cataract, we are sometimes told that the opacity made its appearance after convulsions. In other cases it cannot be traced to any cause.

The only remedy for congenital cataract, as for the cataract which occurs at other periods of life, is an operation.

If the cataract be limited to a small dot or dots of opacity in the middle of the pupil, no operation is immediately called for. When, however, the opacity involves the lens so extensively as to interfere materially with the sight, it is proper to operate.

The period after birth when the operation for the cure of congenital cataract should be had recourse to is before teething commences; or, if that period has been allowed to pass, as soon after teething has been completed as possible.

The reason for the early performance of the operation is this:—As the infant cannot see, its eyes are not fixed on objects, but roll about in a heedless manner. This being allowed to go on, the infant loses command over the eyes, or rather does not acquire command over them; and even if sight be afterwards restored by an operation, the power of directing the eyes properly and steadily owards objects may never be fully gained. See below, *Oscillation* and *Nystagmus*.

It is also to be observed that good sight is more likely to be restored by an early operation. Moreover, the important opportunity of education of and by the sight is secured.

The cataract of infants and children being soft lenticular, the operation is division by sclerotic puncturation p. 396). Extraction through a puncture-section of the cornea has also been performed with success, but as a general rule it is not to be recommended. Infants above wo years old may be put under the influence of chloroform; but this is scarcely necessary in the case of younger nfants.

They are sufficiently secured by wrapping them in a shawl, to confine their arms and hands, and laying them on their backs on a table.

The tender and delicate constitution of early infancy is no objection to the performance of the operation, because his is in itself extremely gentle. Not more than half a minute is taken up in its performance, and the pain is not greater than that of the prick of a needle. The nfant will cry at the moment, but very soon after becomes pacified.

Usually no inflammation results, and in the course of some weeks the opaque lens is removed by absorption and sight proportionally restored.

Not unfrequently, however, some degree of opacity of the capsule supervenes, which will require a repetition of the operation for its removal from behind the pupil.

In children, as just mentioned, the central nucleus of the lens is sometimes opaque, the circumferential part being as yet quite transparent; or, though somewhat opaque, transparent enough to allow the circumscribed opacity of the nucleus to be seen.

In nuclear and in central capsulo-lenticular cataract, materially interfering with the sight, the question arises whether, instead of operating on the lens, it would not be better to open a passage to the light through the clear circumferential part of the lens by the operation either of iridectomy or of displacement of the pupil by iridodesis.

Against such a proceeding stands the likelihood of the circumferential part of the lens eventually becoming opaque also, and thus necessitating not only the removal of the lens in the long run, but also an operation to correct the excentric position of the pupil.

On the other hand, the advantage of cataract glasses not being required, which is very great in the case of children, recommends the proceeding, even although it may come to be necessary at a later period of life to have recourse to the operation for cataract in consequence of the extension of the opacity to the circumferential part of the lens. See below, the operations for artificial pupil by iridectomy and by dislocation of the pupil.

SECONDARY CATARACT.

After the operation of extraction, some portion of the cataractous lens may remain obstructing the pupil, forming what is called secondary lenticular cataract. In such a case no interference is in general required, except keeping the pupil dilated by belladonna, the lenticular fragments being eventually absorbed. The posterior strata of the lens, both opaque and firm, sometimes remain adhering to the posterior wall of the capsule, and show little disposition to become absorbed. In such a case I have found it necessary to perform the operation of division some weeks after the extraction had been performed.

After the operation of extraction, and especially after that of division, the capsule is liable to become opaque and obstruct the pupil. This forms secondary *capsular* cataract.

Operation for secondary capsular cataract.—At the same time that the capsule becomes opaque, it is apt to become thickened and very tough; it may not therefore be easy to divide it, so as to make an opening through it, opposite the pupil, but this should be first attempted with the needle or cannula scissors. If the opaque capsule admits of being detached in a mass, it should be extracted through a small section of the cornea, or through a puncture of the sclerotica, as above recommended, provided the vitreous body be sound. If there is reason to suppose that the vitreous body is in a state of dissolution, it will be safer to displace the opaque capsule in the manner above described (p. 411).

COMPARATIVE ADVANTAGES AND DISADVANTAGES OF EXTRACTION, DISPLACEMENT, AND DIVISION.

By the operation of extraction, the cataract is removed wholly and at once from the eye, and very good vision restored; but the operation is a nice, if not a very difficult one, and is liable to the occurrence of the various accidents above mentioned, by which its success is readily marred.

The operation of displacement, which may be performed in the same cases as extraction, is neither so nice nor so difficult an operation, and does not expose the eye to the same immediate risk. The cataract, however, is apt to return to its former place. But even, though displacement may have succeeded as an operation, the eye is not so safe as after successful extraction, but, as above mentioned (p. 411), is liable to become affected with internal inflammation, which ends in amaurosis.

Extraction thus possesses a decided advantage over displacement, and is therefore generally preferred, except when the unfavourable complications above mentioned exist (p. 363).

The degree of softening of the vitreous body requisite to admit of safe displacement of the lens is not so great as to forbid extraction; but, of course, if, in the cases in which the vitreous body is so much dissolved, that the displaced lens is apt to float up again, displacement be contra-indicated, extraction is much more so.

All other things being equal, it might perhaps be laid down as a general proposition, that in the very cases in which displacement admits of being most readily and safely performed, extraction is less safe, whilst, on the other hand, in the cases in which, in consequence of the soundness of the vitreous body, extraction is most safely and easily performed, displacement is least so.

As the cases for which division is best fitted are different from those in which extraction or displacement is indicated, there is no comparison to be made between them. It is, however, to be observed, that soft cataracts may be successfully extracted through a small section of the cornea, and firm cataracts divided. A combination of division and extraction has sometimes been had recourse to in cases of common lenticular cataract of old people. The object of this compound operation being that the lens may, by solution and absorption of its soft exterior part, be reduced to its hard nucleus, which in consequence of its small size, will admit of being extracted through a puncture-section of the cornea. This is a proceeding, however, not at all to be recommended In any such case, where there is reason to dread making a larger section of the cornea, it is better not to extrac at all, but divide the soft exterior of the lens and recline the nucleus.

In the case of a mad woman, about sixty years of age on whom I could not venture to perform extraction. divided the soft exterior of the lens and reclined the nucleus in both eyes at the same sitting, with good suc cess; one repetition of the division being required. The operations were performed while the patient was unde the influence of chloroform.

CATARACT GLASSES.

The difference in refractive power between the air an the cornea, being much greater than between the aqueou humour and crystalline body, the greatest amount of re fraction which the rays of light undergo in the eye, i order that they may converge to foci on the retina, is tha effected by the cornea on their first entrance. The crys talline body contributes comparatively little to the convergency. Hence, vision, after a successful operation for cataract, may be still *tolerably distinct* for objects at a certain distance. Still, in order that it may be *perfectly distinct*, the use of convex glasses is required.

But as with the loss of the crystalline body, there is loss of the faculty of the eye to adjust itself for different distances, except so far as variations in the size of the pupil contribute to that effect, glasses of different degrees of convexity are required according as the patient wishes to view near or distant objects. Thus, convex lenses of two and a half inches focus are generally required for reading, and lenses of four and a half inches focus for viewing distant objects.

Of course before fixing on any particular powers, the patient will try which suit him best, and the test which should guide him in his choice is, that when the spectacles are put on, or, if hand-glasses, when they are held immediately before the eyes, he sees objects distinctly at the same distance as he saw them before he became blind.

Recourse is not to be had to the use of cataract glasses until the eyes have perfectly recovered from the operation, and have been so for some time.

SECTION III.—OPERATIONS FOR ARTIFICIAL PUPIL.*

An artificial pupil is an opening made in the iris, to give passage to the rays of light when the natural pupil is ither, 1st, covered by extensive central opacity of the cornea, with or without being contracted, or complicated with ynechia; or, 2nd, when it is actually obliterated, with or without being complicated with opacity of the cornea r synechia,—so that the rays of light can no longer be ransmitted through it to the retina.

There are three principal modes of operating for arti-cial pupil which may be had recourse to, according to he nature of the case, viz., first, making the opening by cutting out a piece of the iris—*the operation by iridectomy*, or *excision*; second, making the opening in the iris by means of a simple incision or incisions—*the operation for artificial pupil by iridotomy*, or *incision*; third, instead of actually making an opening in the iris, detaching the membrane at some part of its circumference from its ciliary connexion—*the operation by iridodialysis*, or *separation*.

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* Conformatio pupillæ artificialis—Coremorphosis—Coreplastice.

In some cases, the natural pupil admits of being so freed, as to be again available for the transmission of light to the retina. The operations by which this is effected, though not strictly operations for *artificial pupil*, are properly enough referred to the same head, as, both in their performance and in their object, they closely agree. The operations are :—First, the restoration to its natural position of the pupil dragged opposite a leucoma by partial anterior synechia, by means of *abscission of the band of adhesion*. Second, the *dislocation* of the natural pupil to opposite a clear part of the cornea.

In the cases in which an artificial pupil is required, the crystalline body may be healthy, or it may have been removed by a previous operation for cataract (of which operation the condition requiring the formation of an artificial pupil may be an effect) or it may be cataractous. In the first place, the crystalline must be preserved untouched; in the last case, the operation for artificial pupil will require to be combined with that for cataract.

In cases of nuclear or central cataract, with the circumferential part of the lens quite transparent, a passage for the light may be opened up by lateral excision, or by dislocation of the pupil, instead of operating on the affected lens itself.

General conditions necessary, or at least favourable, to the success of operations for artificial pupil.

An operation for artificial pupil is not to be thought o

unless there is reasonable evidence that the retina is stil sound.

Besides being free from inflammation, the eye shoul also be otherwise tolerably healthy in its anterior segment.

As the eye requiring the formation of artificial pup has in general already suffered so much from inflammation, this process is apt to be re-excited to such a degree as to occasion failure of the operation, or even complete destruction of the eye. Inflammation is especially prone to supervene if that which caused the state of the eye requiring the artificial pupil has been scrofulous, syphilitic, or gouty.

If the inflammation which has caused the state of the eye requiring the artificial pupil has been scrofulous in a child, no operation should in general be attempted until after puberty. The most promising cases are those in which the condition of the eye requiring the operation is of traumatic origin, as after operations for cataract, or has been occasioned by purulent ophthalmia.

The amount of vision restored by the operation depends upon the previous state of the eye, and the mode of operating, which that state permitted to be adopted, together with the degree of reaction which follows the operation.

Preparation of the patient for the operation for artificial pupil.—In addition to the same general treatment above laid down for the operation for cataract, in order to get the patient into as good a state of general health as possible, the preparation for undergoing the operation for artificial pupil should consist in bringing the eye into the favourable condition above mentioned.

Place of the iris where the artificial pupil should be made.—The artificial pupil should be made, 1st, as near the middle as the circumstances of the case will allow; 2nd, after the middle, the nasal or temporal side is the next best place; then the lower, and lastly the upper.

Position of the patient, assistants, and operator.—This should be the same in general as above recommended for the operations for cataract (p. 359, et seq.).

The *securing of the eyelids* also is to be effected in the same way as above recommended (p. 360, et seq.).

ARTIFICIAL PUPIL BY IRIDECTOMY, OR EXCISION OF A BIT OF THE IRIS.

There are two principal plans of excision, viz., lateral excision, and central excision.

Lateral excision is the more important, as it is applicable to cases in which the lens is transparent, and in which it may and ought to be preserved so.

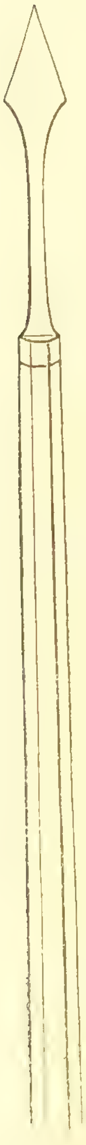

Fig. 161.

Central excision is applicable chiefly in cases of closed pupil occurring after the operation for cataract, or combined with cataract.

1st.—*Lateral excision.**

Lateral excision is performed by making a puncture-section of the cornea at some convenient part of its circumference, seizing with a forceps the piece of iris which protrudes, and snipping it off, taking care to include the pupillary margin of that part of the iris. If the iris does not protrude spontaneously, the portion to be snipped off is drawn out with a blunt hook or the forceps, care being taken not to injure the crystalline body.

The cases in which the formation of artificial pupil by lateral excision is applicable are:—1st, cases of central opacity of the cornea, to such an extent as to cover the pupil, even when dilated by belladonna, in which the iris and pupil are either natural, or the former but partially adherent to the cornea, and the latter partially contracted;—the lens being still clear; 2nd, cases in which the transparency of the cornea is unimpaired, but in which there is obstruction of the pupil by opaque deposit of lymph, and extensive adhesions of the pupillary margin to the capsule of the lens,—the lens being in other respects still transparent.

The conditions necessary for lateral excision are:—1st, a sufficient extent of clear cornea at that part of its circumference where the pupil is to be made, to allow for any opacity which may result from the cicatrice of the corneal incision, and that enough of clear cornea may remain opposite the new pupil; 2nd, the iris sufficiently free from adhesions to admit of a portion of it protruding or being drawn out through the corneal incision, in order to be excised.

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* The operation of Beer and Gibson.

The eyelids are secured in the same way as in the operation for cataract, during the first step, or section of the cornea, but during the second step, or excision of the piece of iris, both eyelids must be secured by the assistant, or one eyelid by one assistant, the other by another, as the operator requires to use both hands.

The instruments required for the operation are:—

1. A cataract-knife, or lancet-shaped knife, Fig. 101, for making a puncture-section of the cornea.
2. The canula forceps (Fig. 86, p. 392), or other fine forceps, Fig. 102, for laying hold of the piece of iris to be excised, or if the iris does not protrude spontaneously, drawing it out through the puncture of the cornea.
3. A pair of curved scissors, for snipping off the piece of iris, Fig. 103, p. 422.

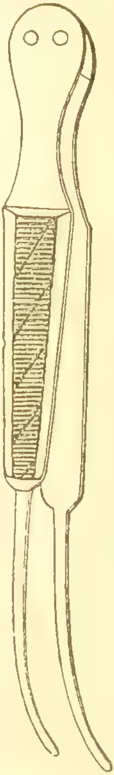

Fig. 102.

Lateral excision comprehends the following steps:—

First step.—Puncture or section of the cornea.—This is to be made close to the sclerotica, but, unless there be a very small extent of clear cornea, not on the sclerotic side of its clear margin, as directed at p. 152, where the operation for a purpose other than artificial pupil is described, and to the extent of one-fourth of the circumference of the cornea.

Second step.—Excision of the piece of iris.—The gush of aqueous humour which takes place on completing the section of the cornea will perhaps cause prolapsus of the iris.

The operator, leaving the eyelids in charge of his assistant or assistants, exchanges the knife for the fine forceps, and takes the curved scissors in the other hand, holding them in the manner represented in Figure 103 (next page), the thumb in one ring, the ring-finger in the other, the point of the fore-finger on the joint, the middle finger on the branch in the ring of which the ring-finger is, with their convexity towards the eye, ready for use.

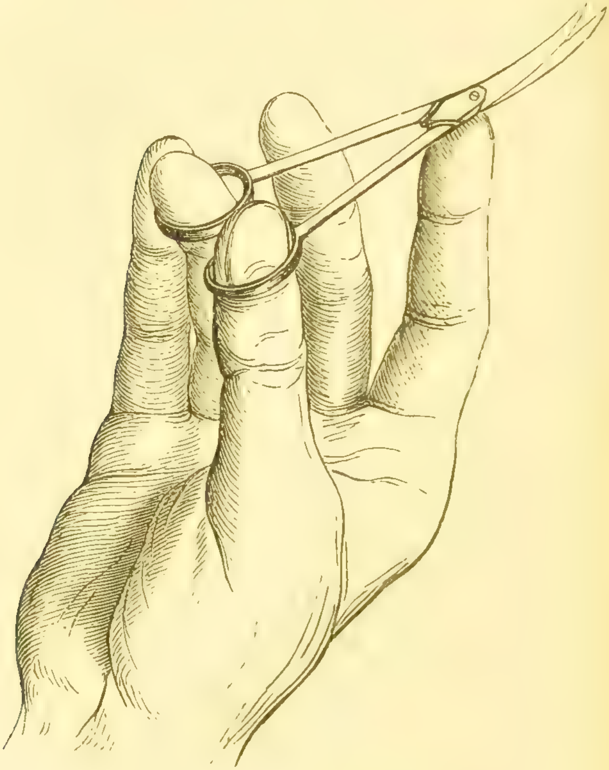

FIG. 103.

If prolapsus of the iris has already spontaneously taken place, it is seized with the forceps, raised up, and a portion, including the pupillary margin, snipped off. If, in consequence of synechia, the prolapsus has not taken place, and cannot be made to do so by gentle pressure, the operator carefully introduces the forceps, lays hold of the iris very cautiously at a little distance from the pupillary margin, close to the junction of the larger with the smaller circle of the iris, draws it out, and snips it off.

The size of the new pupil should be about equal to that of the natural pupil in its middle state. As to the quantity of iris to be cut off, in order to obtain a new pupil of this size, it is to be remembered that if the structure of the iris is healthy, even when but a small piece is snipped off, the aperture which results will be of considerable size.

What of the iris may remain protruding is to be gently pressed back with the curette. The eyelids are then to be closed, rubbed over the cornea, and suddenly opened to the light.

A man of about twenty-five years of age, had extensive opacity of the centre of the cornea of both eyes in consequence of gonorrhœal ophthalmia. The pupil, while of its medium width, was covered by the opacity, but when dilated by belladonna or atropia, its circumference extended slightly beyond the densest part of the opacity, so that the patient was able to see objects, though very indistinctly, and to make his way in the street.

Seeing that there was no hope of any further clearing away of the opacities, I resolved to perform the operation for artificial pupil by lateral excision.

The left eye was first operated on. The upper eyelid having been secured by an assistant, I made, with a cataract knife, a section of the cornea to the extent of a quarter of an inch at its inner and lower margin. Immediately on this being completed the aqueous humour escaped, and the adjacent part of the iris became prolapsed. The eyelids were now allowed to close, while the aqueous humour at the inner corner and on the cheek was wiped away with small pieces of lint. The eyelids were then again opened, and the one secured by one assistant and the other by another, whereupon I seized the protruding portion of iris with a fine tooth-pointed forceps and snipped it off, taking care to include the pupillary edge. The eyelids were then allowed to close again. After about a minute, the upper eyelid was gently rubbed over the cornea, and then suddenly opened to the light. A sufficiently good pupil having been obtained, no more of the iris now protruding, and the edges of the corneal wound being in apposition, the lids were finally closed and retained by a narrow strip of plaister.

A week after this operation, the healing process having gone on most favourably, I considered it advisable to operate on the right eye. The operation was performed exactly in the same manner as on the left eye. A fortnight after, the patient was convalescent, and able to make out large printed words by the aid of convex glasses six inches focus.

The sight has gone on improving so that he can see to read and write a little with the help of spectacles.

Figure 104 represents one of the eyes.

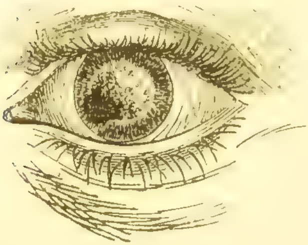

FIG. 104.

2nd.—*Central excision.*

In cases of closed pupil occurring after the operation for cataract, the plan of central excision which I have adopted is very simple. It consists in puncturing the cornea about halfway between its margin and centre, allowing the aqueous humour to escape without withdrawing the instrument, and puncturing the iris also as it is falling against the cornea. This being done, the forceps is introduced, the central part of the iris seized by the edge of the puncture in it, drawn out, and cut off.

In cases of closed pupil, central excision, as performed by Wenzel, consisted, first, in making a half section of the

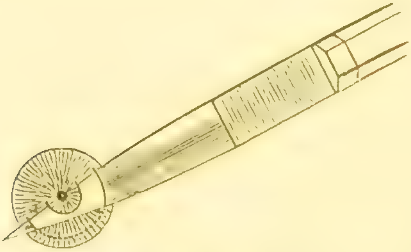

FIG. 105.

cornea as for extraction, with the additional manœuvre of so puncturing and counter-puncturing the iris with the point of the knife in its passage through the anterior chamber, that in the act of cutting out, a semicircular flap of the iris was formed. This flap of the iris was then cut off with a small pair of scissors, introduced through the incision of the cornea, and the cataract, if present, extracted.

ARTIFICIAL PUPIL BY INCISION.*

There are two principal ways of operating for artificial pupil by incision, viz., through the sclerotica, and through the cornea. An important condition for the success of incision performed either way is, that the larger circle of the iris be still in a healthy state, as regards intimate structure and contractile endowments, so that the opening made in it may, by its retraction, come to gape, and the edges of the incision thus be prevented from reuniting.

In the cases which may be the subject of the operation of incision, the closure of the pupil may have been the consequence of iritis succeeding an operation for cataract. If the lens is still present but cataractous, it may be divided or displaced in the operation through the sclerotica; extracted in the operation through the cornea. If, however, the lens be still clear, some other operation than incision must be chosen, by which the lens may be preserved untouched.

1st.—*Incision through the sclerotica.*†

This was the first kind of operation performed for artificial pupil. The two cases in which Cheselden operated, were cases of closed pupil, after the operation for cataract, by couching.

In this operation, a single incision is made through the iris in a transverse direction, above or below the situation of the natural pupil. The radiating fibres being thus cut across, the edges of the incision retract, and a fusiform opening is the result. The cases in which this succeeds best are those in which the closure of the pupil is owing

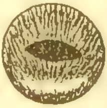
FIG. 106.

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* Iridotomy.

† Cheselden's operation for artificial pupil.—Philosophical Transactions, vol. xxxv. An. 1728.

to the iris having been prolapsed through a wound or large ulcerated opening of the cornea, and is thus on the stretch. It will also succeed in simple closed pupil, provided, as above said, the substance of the larger circle of the iris is still quite healthy. There should be a sufficiency of clear cornea opposite the place where the incision of the iris is made.

The instrument for incision through the sclerotica.—The instrument used for this purpose, and known under the name of Adams' iris knife, has a blade about nine-tenths of an inch long, about one-twentieth of an inch broad, single-edged, and sharp, but somewhat bellied at the point. (Fig. 107.)

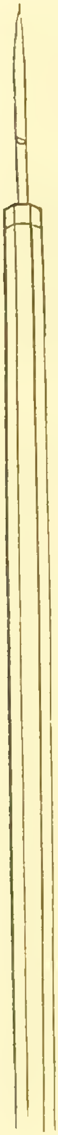

Fig. 107.

The operation comprehends the following steps :—

First step.—Puncturation.—The point of puncturation is the same as in the operation for reclination of cataract, viz., three-twentieths of an inch from the temporal margin of the cornea, and in the line of its transverse diameter.

The operator holds the knife, like the straight cataract needle in reclination, its surfaces upwards and downwards, its cutting edge backwards, and rests his hand by the little finger on the patient's cheek, in such a way that the blade of the knife is close in front of the cornea, in a line corresponding to its transverse diameter, and the point extending to nearly opposite the nasal margin. The hand being thus disposed, the thumb and fingers holding the knife are retracted, in order that the point may be applied perpendicularly to the surface of the eyeball, at the place above mentioned, when it is to be steadily thrust towards the centre of the eyeball, but no deeper than about one-eighth of an inch.

Second step.—The handle of the knife is now to be inclined *very much back towards the temple*, more than in the operation for cataract, in order that the point of the knife, when pushed on, may come to pierce the iris from behind, near its temporal margin, say one-tenth of an inch from it, and appear in the anterior chamber. This being effected, the handle of the knife is now to be inclined forward a little, so that when the knife is pushed further on, its point may pass across the anterior chamber, towards its nasal side (Fig. 108).

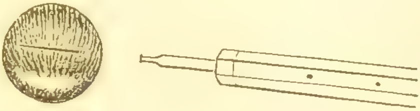

FIG. 108.

Third step.—Incision of the iris.—By now inclining the handle of the knife still more forwards, so that its edge may be fairly applied against the iris, and then by withdrawing it somewhat, it is made to cut the iris. If by this first stroke the incision of the iris is not sufficiently large, the knife is to be again pushed on and again withdrawn, its edge being still kept fairly directed against the part of the iris to be cut. This is to be repeated until a sufficiently large incision, about one-fifth of an inch, has been made. By the contraction of the iris, previously on the stretch, this incision immediately gapes, and that to a considerable degree, and so the fusiform pupil is made.

In this step of the operation, it may happen, especially if the edge of the knife is unduly pressed back against the iris, that the iris becomes detached from its ciliary connexion at some point, most frequently at the nasal side. This will impede the completion of the incision to the proper size. The aperture left by the separation may continue open, especially if the iris is healthy in its texture, but more frequently it will close from supervening inflammation. In such a case, incision, or some other operation through the cornea, may be subsequently had recourse to.

This operation for artificial pupil by incision has fallen into disuse, as it is found in practice not an easy thing to make a sufficient incision of the iris, whilst, even

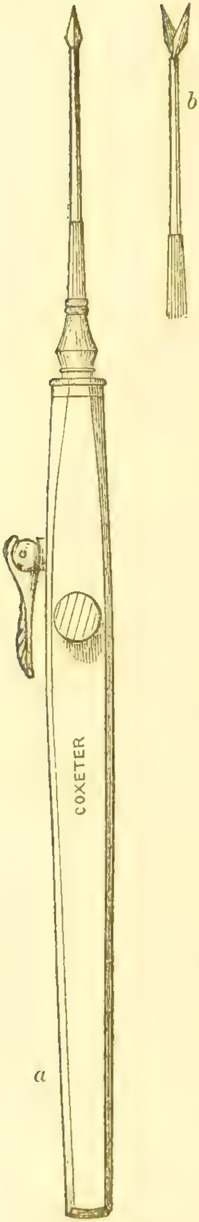

FIG. 109.

when made, it is liable to close again. An incision may, however, be more easily made by means of the cannula scissors, Fig. 109, the puncture of the sclerotica having been premised as above described, to make way for the more easy introduction of the instrument.

2nd.—*Incision through the cornea.*

Incision with the iris knife or cannula scissors has also been performed through the cornea.

Janin's operation, as improved on by Maunoir, which used to be a good deal practised, consists in making a small section of the cornea at its lower and outer or its lower part, and by means of fine scissors introduced through the opening, dividing the iris by two incisions divaricating from the situation of the natural pupil (Fig. 110). By this both the circular and radiating fibres of the iris are divided. Modifying this plan, which cannot always be followed, Dr. Mackenzie cuts the radiating fibres only, making the incisions divaricate from a point near the margin of the iris (Fig. 111).

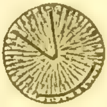

FIG. 110.

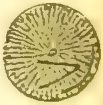

FIG 111.

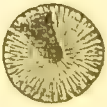

FIG. 112.

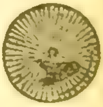

FIG. 113.

In either case, the result of the two incisions is a triangular flap of iris, which contracts and shrivels, so as to leave a free opening. (Figs. 112, 113.)

The two incisions in this operation are made when the iris is not on the stretch, and when there is reason to suppose that the substance of the iris is not so healthy as to contract sufficiently to cause a single incision to gape, and thus to form a pupil which shall remain permanently open.

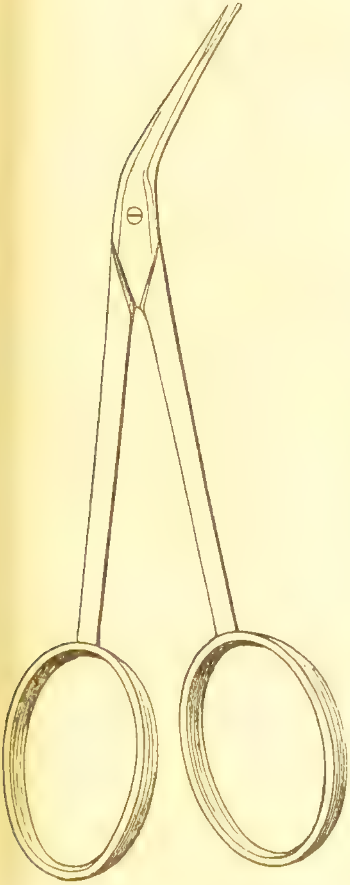

FIG. 114.

The instruments required for the operation are, an extraction knife and a pair of Maunoir's scissors (Fig. 114). The other instruments employed in extraction should also be ready (p. 364).

Maunoir's scissors are extremely fine, when closed not so thick as a common probe, bent sideways at an obtuse angle, the blade corresponding to the convexity sharp at the point for piercing the iris, the other blade probe-pointed, that it may admit of being easily and safely pushed through the anterior chamber.

The operation comprehends the following steps:—

First step.—Section of the cornea.—This is to be made at the outer and lower part or the lower part of the cornea, as for extraction of the cataract, but to the extent only of about one-fourth of the circumference of the cornea, unless it is contemplated to extract the lens or an opaque capsule, when the section should be to the extent of one-third of the circumference.

Second step.—Introduction of the scissors and incision of the iris.—The surgeon introduces the scissors closed under the flap of the cornea, and when the point has arrived at that part of the iris where the incision is to be commenced—the situation of the natural pupil or near the margin of the iris, according to circumstances—he opens them, thrusts the sharp-pointed blade through the iris, and pushes them on, the sharp-pointed blade through the posterior chamber, the probe-pointed blade through the anterior chamber, the iris between them, to the opposite part of the margin of the iris where the incision is to terminate. By now closing the scissors, which should be done sharply, the iris interposed between the blades is cut.

The second incision is now to be made, commencing at the same point as the first, but divaricating from it (Figs. 110, 111). For this purpose the scissors, still kept closed, are to be withdrawn and re-introduced in the direction in which it is proposed to make the second incision. When the point of the scissors is now opposite the commencement of the incision which has just been made, the sharp-pointed blade is passed behind the iris, and the scissors pushed on, then closed, and the incision made as before.

An additional step which may be called for, is extraction of the lens, if present, or of an opaque capsule.

ARTIFICIAL PUPIL BY SEPARATION.*

This operation, which, like Maunoir's, is now almost never performed, consists in detaching the iris from its ciliary connection at some convenient part, and drawing it aside, so as to provide a passage for the light. It may be performed through the sclerotica or through the cornea. Performed through the cornea, the lens, if clear, may be preserved so.

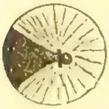

FIG. 115.

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* Iridodialysis.

Separation through the cornea.

When the iris is in a healthy state, an opening made by separation will remain permanent, in consequence of the contraction of the iris, as is shown in cases of accident, in which, by a smart stroke on the eye, the iris has been detached at some part of its ciliary connexion. But in the cases in which separation is designedly had recourse to for the purpose of making an artificial pupil, the permanency of the opening cannot in general be calculated on, in consequence of alterations in the structure of the iris, produced by the disease which occasioned the necessity for the artificial pupil.

In order, therefore, to ensure the permanency of a new pupil made by separation, the ciliary margin of the detached portion of iris is drawn out through the puncture of the cornea by which the detaching instrument was introduced, and either left there to be united in the cicatrice or cut off.

Cases in which separation is applicable.—Separation is applicable in all cases, but as it is not so good an operation as excision or incision, it is had recourse to in those only in which neither of these two modes of operating is admissible. The cases are:—

1st. Such extensive central opacity of the cornea, that the clear circumferential part is too small to admit of being encroached on by the opacity which might result from the cicatrice of an incision made for lateral iridectomy.

In the case now mentioned, the iris and its connexions being natural, separation is more easy and more successful than in the cases next to be mentioned; and, although the new pupil might remain permanent, without strangulating the detached portion of iris in the puncture of the cornea, or cutting it off, it is nevertheless proper, for the sake of certainty, to add one or other of these steps to the simple separation.

2nd. Extensive central opacity of the cornea and adhesion of the pupillary margin of the iris to it, in which, in consequence of the narrowness of the circumferential portion of cornea remaining clear, the opacity of a cicatrice cannot be risked for Maunoir's operation, and in which not even incision through the sclerotica promises anything, in consequence of the morbid state of iris behind the clear part of the cornea, or in consequence of the situation of that part; or when, although incision

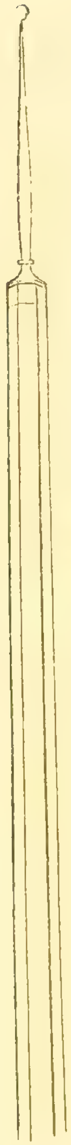

FIG. 116.

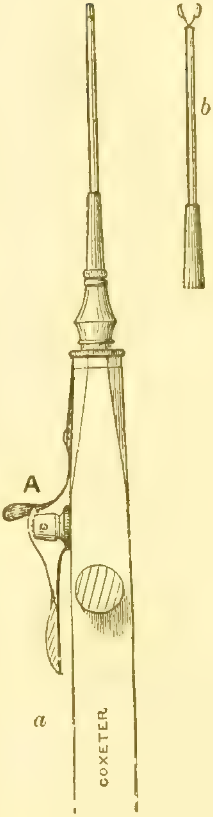

FIG. 117.

might be otherwise admissible, the lens is clear, and it is desirable to preserve it so.

As considerable pain attends separation, the assistant must secure the head well, to prevent any sudden movement, by which the operator might be made to detach more of the iris than necessary.

Instruments for the operation.

1. Jaeger's keratome, Fig. 101, or Beer's cataract knife.
2. A simple hook, Fig. 116, or the cannula forceps, Fig. 117.

The steps of the operation are:—

1st. Puncture of the cornea by which to introduce the hook or forceps.

2nd. Introduction of the hook or forceps through the puncture of the cornea, into the anterior chamber.

3rd. Seizure and detachment of part of the iris. And,

4th. Prolapsus of it through the corneal puncture.

Puncture of the cornea.—This should be about one-tenth of an inch in length; the place where it should be made, which is an important point to determine, depends principally on the part of the iris to be detached, but in some measure also on the state of the cornea, for the incision ought, if possible, to be made at a part of the cornea where there is no adhesion of the iris.

The opening in the cornea is made by simple punctuation with the keratome or cataract knife, but, at the same time, care is to be taken to make the opening as wide within as without, otherwise the prolapsed piece of iris will not be so readily retained. Iridodesis, however, would secure this more effectually (p. 435).

Introduction of the hook or forceps.—Having made the incision in the cornea, the operator lays aside the knife for the hook or forceps. The former he holds, like a cataract needle, and introduces it, if used, convexity foremost, and flatways through the opening in the cornea, and in the direction of its axis, into the anterior chamber. The hook being fairly in the anterior chamber, the handle of the instrument is to be inclined so far backwards that its blade may come to be parallel between the iris and cornea. This being arranged, the instrument is to be pushed on through the anterior chamber, with its sharp point, if anything, rather towards the iris than the cornea, as far as the ciliary circumference of the part of the iris to be detached. Before attaining this point, a little of the extremity of the hook disappears behind the margin of the sclerotica. If the forceps is used, it is, of course, introduced closed, and opened only when the iris is to be seized.

Seizure and detachment of part of the iris.—Having thus gained the ciliary circumference of the iris, the handle of the instrument is to be so far rotated and inclined, that the point of the hook may be directed fairly against the iris, and fixed into it, and that as close to the ciliary circumference as possible.

The iris being hooked, the instrument is to be rotated and inclined, so that it may be brought back to the position it was in before the iris was hooked. A steady and sustained, but gentle pull or two is now to be made, until the iris begins to separate. When this takes place the instrument is to be rotated half on its axis, so that the iris may be the more securely hooked. If this manœuvre be attempted before separation has commenced, the iris, being often diminished in the cohesion of its texture, will only be torn, and the hold of it by the hook altogether lost. By now continuing to pull the instrument slowly and steadily, separation goes on.

Prolapse of the separated portion of the iris through the corneal incision.—When the hook arrives with the hooked part of the iris at the puncture in the cornea, some nice manipulation is required to bring it out without letting the iris slip away. The essential point is to press back the lip of the corneal puncture, which is behind the blade of the hook, in order to make the puncture gape.

For seizing, detaching, and prolapsing the iris, the cannula forceps is altogether a much more efficient instrument than the hook.

As much of the iris at least is to be prolapsed as will suffice to secure its retention in the corneal wound, and as much more as may be necessary to make the new pupil of proper size. In order to the retention of the prolapsed iris, it is to be drawn to one or other end of the puncture, and jammed there between its lips, or, what would be better, secured by *iridodesis*.

If it be necessary, in order to obtain a proper sized pupil, to draw more of the iris out than is actually necessary for its being retained in the corneal incision, the superabundant part should be cut off. This may happen when the state of the eye has rendered it necessary to make the incision of the cornea nearer the margin where the new pupil is to be, than was above indicated.

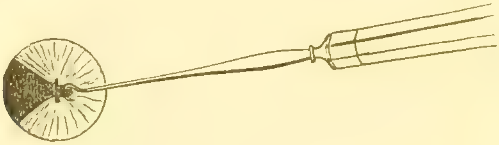

FIG. 118.

When the prolapsed iris cannot be retained between the lips of the corneal incision, somewhat more should be drawn out, and the whole cut off (*Iridectomedyalisis*).

OPERATIONS FOR AGAIN RENDERING THE NATURAL PUPIL AVAILABLE.

1st. *Restoration of the pupil to its natural position by abscission.*

If the pupil is dragged by a small synechia anterior, from its natural situation to opposite an opaque part of the cornea, and if it appears that were the adhesion divided the pupil would come to be opposite a clear part of the cornea, the operation to be adopted is simply the abscission of the adhesion. This is effected by means of a needle cutting on the edges and increasing in thickness. It is passed through the cornea into the anterior chamber slantingly, in order that the aqueous humour may not escape, and the adhesions cut. In doing this, great care should be taken not to injure the lens. Injury to the lens may be avoided if the aqueous humour has not been allowed to escape, but not easily if this accident has occurred.

Rather than run any risk of wounding the lens, it would be better to perform lateral excision, or the following operation.

2nd. *Dislocation of the pupil to opposite a clear part of the cornea.*[*]

This is effected by prolapsing a portion of the iris through a puncture of the cornea, on the sclerotic side of its clear margin, and so dragging the pupil away from the middle to opposite the circumferential part of the cornea. The puncture of the cornea is made with an iris knife, or the point of a cataract knife, close to the sclerotica, and should be about one-tenth of an inch in extent. If the iris is not prolapsed by the gush of aqueous humour, it may be so by means of the fine forceps (Fig. 117); or a blunt hook is introduced through the puncture, the iris caught by its pupillary margin and drawn out. The prolapsed portion of iris is left strangulated in the opening of the cornea, in order that it may become adherent in the cicatrice.

3rd. *Dislocation of the pupil with iridodesis.*[†]

As giving effect and precision to the operation of dislocation of the pupil, the additional step of *iridodesis*, or *ligature of the iris*, invented by Mr. Critchett, is to be recommended. The puncture of the cornea being made, the point of the cannula forceps, with a loop of fine silk thread thrown round, as in tying an artery, is introduced,

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[*] Operation of Adams and Himly.

[†] *ἶρις*, and *δέσις*, tying.

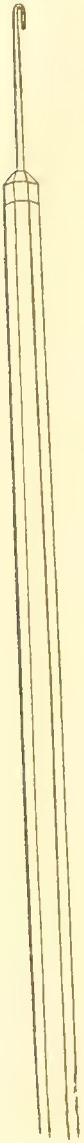

FIG. 119.

the iris seized midway between its ciliary and pupillary margin, and prolapsed: an assistant now slips down the loop of thread, and tightens it round the bit of iris, close to the puncture. A single knot is sufficient. In performing this delicate ligature, each end of the thread may be held with a small broad-pointed forceps, such as the cilia forceps.

The iris at the place of prolapse is included in the cicatrice of the cornea, whilst the bit that was strangulated in the ligature sloughs off, which it does in two or three days.

ARTIFICIAL PUPIL BY LACERATION OF THE IRIS.*

In cases in which the lens is still clear, and the pupillary margin of the iris is adherent to the cornea to a great extent, Tyrrell's hook (Fig. 119) may be introduced into the anterior chamber through a small incision in the cornea, and the iris cautiously hooked by its pupillary margin, and torn by dragging it in withdrawing the instrument.

In cases, again, in which the pupillary margin of the iris is wholly adherent to the cornea, such a mode of operation as the following may be adopted.

The cornea being punctured at that part of its extreme margin indicated by the condition of the parts, the cannula forceps, closed, is introduced through the anterior chamber to the part of the iris to be detached from its adhesion by laceration. The forceps being opened, the iris is seized in a large fold, and a short but sharp and steady pull is made, calculated to tear its substance. This being effected, the detached and torn portion of iris is drawn out of the wound by the forceps, which has never been allowed to let it go, and cut off.

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* Iridorhesis, from ἶρις, and ῥήσσω, to tear.

TREATMENT AFTER OPERATIONS FOR ARTIFICIAL PUPIL.

This should be the same in general as after operations for cataract. The patient is to be kept in bed, his eyes protected from the light, and the antiphlogistic regimen observed. According to the form and severity of inflammation, which may supervene, so must be the treatment. In a majority of cases recovery quickly takes place without any untoward symptom.

If the lens has been removed, the patient will, of course, require cataract glasses, when he comes to use the eye. Even when the lens is still present, as after lateral excision on account of central opacity of the cornea, convex glasses, though of less power, may be required.

INDEX OF THE DIFFERENT MORBID STATES OF THE EYE, IN WHICH VISION MAY BE RESTORED BY THE OPERATION FOR ARTIFICIAL PUPIL, AND OF THE PLAN OF OPERATING, OR MODIFICATION OF IT ADAPTED TO EACH PARTICULAR STATE.

In the above description of the different methods of performing the operation for artificial pupil, the different morbid states of the eye in which they are respectively applicable, have been mentioned. Here, it will now be useful to classify the morbid states and indicate the plan of operation applicable for each species.

Genus I.—OF MORBID STATES OF THE EYE.

Cornea principally affected.—The iris and pupil either natural, or the iris, otherwise healthy in structure, adherent to the cornea, to the degree either of synechia anterior or partial staphyloma, the pupil being more or less dragged and contracted. The lens and capsule sound, or the lens not present.

SPECIES OF MORBID STATES.	PLAN OF OPERATION.
Central incurable opacity of the cornea, of such a size as to cover the pupil, even when dilated by belladonna; iris and pupil quite natural; lens sound.	Lateral excision, or dislocation of the pupil with iridodesis, opposite to where there is the greatest extent of clear cornea.

SPECIES OF MORBID STATES.	PLAN OF OPERATION.
The opacity of the cornea not so extensive, but contraction of the pupil to a greater or less degree, and dragging of it behind the opaque part of the cornea, in consequence of synechia anterior or partial staphyloma; the lens sound.	Reduction of pupil to its natural situation by abscission, if the synechia be small and appears likely to admit of being readily divided. Otherwise lateral excision.
Cases in which the pupillary margin of the iris is adherent to the cornea, either wholly or to a considerable extent; the iris, otherwise sound in structure, but much on the stretch.	If the lens be still present and sound, and if there be a sufficient extent of clear cornea, lateral excision may be adopted in the following manner:—Having made a section of the cornea, the fine forceps is to be introduced, and the iris laid hold of by a fold, and either dragged out, or torn and dragged out, and cut off.

Genus II.—OF MORBID STATES OF THE EYE.

Iris and pupil affected, cornea sound, lens clear or opaque.

SPECIES OF MORBID STATES.	PLAN OF OPERATION.
Simple closure of the pupil, with synechia posterior, from iritis, the lens and capsule supposed to be clear.	Lateral excision, or excision of prolapsed iris through section of cornea half way between centre and circumference.
Closure of the pupil with cataractous lens, and posterior synechia.	Maunoir's operation by incision, with extraction of the cataract through the opening. Or central excision with extraction, may be had recourse to.
Closure of the pupil, after the removal of a cataract.	This was the kind of case in which Cheselden performed his operation by in-

SPECIES OF MORBID STATES.	PLAN OF OPERATION.
	cision, through the sclerotica; and if the texture of the iris has remained tolerably sound, the operation with the cannula scissors may be performed, though central excision would be better, if the texture of the iris appears to be altered.
Partial opacity of the cornea, closed pupil, synechia anterior or posterior, and cataract. This is a combination of all the morbid states above enumerated.	Except in so far as the situation and extent of the clear part of the cornea on the one hand, and the state of the iris on the other, in such cases, necessitates a modification of plan in operating, what has been said in the preceding paragraphs is here applicable.

Genus III.—OF MORBID STATES OF THE EYE.

Cornea and iris unaffected.

SPECIES OF MORBID STATE.	PLAN OF OPERATION.
Central opacity of the lens.	Dislocation of the pupil with iridodesis, or lateral excision.

Section IV.—CONGENITAL DEFECTS OF THE IRIS AND PUPIL.

1st. *Congenital absence of the iris.**

The whole iris may be congenitally absent, or there may be still some trace of it (*complete or incomplete congenital absence of the iris*).

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* Irideremia congenita.

There is a uniform dark, though not the jet black appearance, behind the cornea, but when the light falls upon the eye in a certain direction, a dark red reflection from its bottom is observed.

Both eyes have generally been found to suffer from the congenital defect; which in some cases has been complete in the one and incomplete in the other.

The unfortunate subjects of absence of the iris are often painfully impressed by the too great influx of light into the eye, so that for relief they seek the dark, and keep their eyebrows depressed and their eyelids half closed. Their vision is also imperfect, partly from the dazzling which arises from the impression of too much light on the retina, and partly in consequence of such optical aberrations as it is the function of the iris with its pupil to correct; but, by their habit of keeping the eyebrows depressed and the eyelids half closed, their eyes are somewhat protected from the too great influx of light, and their vision at the same time rendered more distinct.

The eyes may be in other respects perfectly formed, or they may be the subjects of additional malformations. In one case, I found the lenses, which had become cataractous, misplaced upwards, so that the lower margin was nearly in the line of the transverse diameter of the eye.

Cataract in general, sooner or later forms; sometimes it already exists at birth. It often appears tremulous.

Though cataract exists, the vision is still in some degree retained, as the rays of light find a passage to the retina through the *zonula lucida*, which is seen around the circumference of the opaque lens.

In consequence of injury, the greater part of the iris may be detached from its ciliary connection, in which case it shrinks to a small size, and the eye thus comes to appear as if there was incomplete absence of the iris.

Treatment.—The only thing that can be done for cases of congenital absence of the iris, is to wear over the eyes, in the manner of spectacles, arched plates of black horn or the like, having a small aperture or transverse slit in them to see through, analogous to the snow-eyes of the Esquimaux. If the state of vision require it, concave or convex glasses may be fitted into the slits.

When cataract has formed, and if an operation should be thought advisable, division is the mode of operating to be adopted.

Imperfect development of the pupillary circle of the iris sometimes occurs, forming *partial irideremia.*

2nd. *Congenital fissure of the iris.**

The fissure extends from the pupil towards the ciliary circumference of the iris, and its direction is almost constantly downwards.

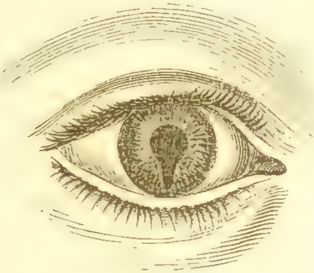

FIG. 120.

In some cases the cleft contracts along with the pupil, though slowly; in other cases, the power of contraction appears to be confined to the pupil.

Vision is in general unimpaired, unless, as sometimes happens, there is some other defect in the development of the eye.

The fissure usually becomes narrow in approaching the ciliary circumference of the iris, but in some instances the opposite disposition has presented itself. In some cases the fissure has been found to implicate the pupillary edge of the iris merely like an angular notch. Again, a peculiar variety of the defect has been met with, viz., consisting of a fissure in the proper substance of the iris only, whilst the uvea remained perfect.

Sometimes one eye alone is affected with congenital fissure of the iris; sometimes both. A case is on record in which there was this malformation in one eye, and in the other a double pupil, like the figure of 8.

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* Coloboma iridis congenitum—Iridoschisma.

In general, the lower half of the eye is less convex than the upper, and apparently less developed. In some cases the whole eye has appeared smaller than natural, the cornea flatter, the pigment deficient, and the eyeball oscillatory. In other cases, a complication with cataract has been found to exist, but a considerable degree of vision still remained, as the light penetrated to the retina through the fissure of the iris, and thence through the zonula lucida by the circumference of the lens. In numerous cases, however, the eyeball has appeared quite natural in other respects, and vision good.

The malformation has been observed to be hereditary in families.

It has been found on dissection that the colomba iridis was a part of a more extensive fissure, involving both the retina and choroid. Coupling this with the fact, that at a very early period a fissure extends through the retina and choroid, at the lower part, we are readily led to perceive that congenital fissure, implicating the lower part of the iris, is owing to an arrestment of development. In those cases, however, in which, as is said, the fissure implicated some other than the lower part of the iris, the defect cannot be attributed to this cause.

In almost all the cases of *coloboma iridis et choroideæ*, which Dr. Liebreich has examined ophthalmoscopically, a similar appearance, though in different degrees, has presented itself, *viz.*—An oval white spot, of which the upper end was directed towards the optic nerve, or embraced it entirely, and of which the lower end approached more or less nearly the ciliary processes. Over this spot there ramified some retinal and very small choroideal vessels, the latter of which followed a very unusual course and penetrated laterally into the margin of the choroid, which for the most part contained a great deal of pigment. The optic nerve, when the coloboma merely embraced it below and it remained well defined above, was only imperfectly distinguished towards the other sides by its somewhat redder or grayer coloration from the bluish-white sclerotica. Its form was elliptical, with the long axis horizontal.

The ramification of the vessels on the papilla deviated much from the usual appearance, especially in this, that by far the greatest part of the branches turned upwards after their exit, whilst some only, and those very fine, ran downwards.

In cases of coloboma extending to the choroid, the membrane which forms the continuation of the retina over the fissure of the choroid, Dr. Liebreich thinks contains few or no nervous elements in its composition. This opinion is founded on the appearance of the form of the papilla, course of the retinal vessels, and the defect of the patient's field of vision corresponding to the defective part of the eye.

Fissure of the iris from injury (*coloboma iridis traumaticum*) may occur at any part of the iris, and to any extent. There being usually injury of some other part of the eyeball, the mere fissure of the iris is not the principal part of the case.

Misplacement of the pupil and deformity of it, are sometimes met with as congenital malformations. In an infant whose parents were first cousins, I found the pupil of the right eye small and seated towards the upper and temporal side, and the pupil of the left, somewhat larger towards the lower and temporal side, with a slight coloboma apparently implicating the proper substance of the iris only. There was a white central capsular cataract with grayish lenticular opacity in each eye.

The existence of more than one pupil has been above noticed (p. 442).

3rd. *Persistence of the pupillary membrane.*

Persistence of the pupillary membrane has been alleged as a condition sometimes met with requiring an operation for artificial pupil; and as instances, Cheselden's operations are referred to, never any others. Cheselden's operations, however, were not performed in cases of persistent pupillary membrane, but, as above mentioned p. 425), in cases of closed pupil, after the operation for cataract.

Though the pupillary membrane may sometimes still exist at birth, it ere long disappears.

Persistence of remains of the pupillary membrane is sometimes, though rarely, met with. In one case,—the ubject of which was a German girl, aged sixteen, who came under my notice on account of something the matter with the other eye,—I found them simulating the form of bands of adhesion between the iris and capsule of the lens. Their real nature was recognised by the circumstance that they sprang not from the pupillary margin of the iris, nor from behind it, as adhesions do,

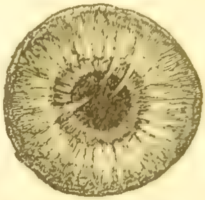

FIG. 121.

but from the anterior surface of the iris, where the pupillary joins the ciliary ring, which is the place where the pupillary membrane is connected with the iris. In another case,—the subject of which was a middle-aged woman, and who made no complaint of her sight,—the remains of the membrane presented themselves in the form of a small patch of membrane (partially covering the pupil) from which bands extended to the anterior surface of the iris where the pupillary joins the ciliary ring.

CHAPTER IV.

SECTION I.—ABNORMAL STATES OF THE OPTICAL ADJUSTMENTS AND REFRACTIONS OF THE EYE.

CONDITIONS ON WHICH THE MOVEMENTS OF THE PUPIL DEPEND.

THE pupil is, in dull light, of its medium size, which is about one-fifth of an inch in diameter. It becomes contracted to a smaller width when the light to which the eye is exposed is strong; but, on the contrary, dilated to a larger size, when the light is weak. During sleep the pupil is contracted. Some time after death it is found of the medium width, showing that when it is so, as I many years ago insisted, the iris is in a state of relaxation.

Contraction of the pupil to a smaller, and dilatation of it to a larger size, are consequently manifestations of an active state of the iris, the former of its circular, the latter of its radiating fibres. The contractions of either of these sets of fibres having ceased, it is the elasticity of the iris which brings the pupil back to its medium diameter. This I long ago showed, so far as the cessation of the action of the radiating fibres is concerned, by the following experiment:—Having divided the anterior segment of an eye from the posterior and removed the lens from the former, I placed it under water, and inserting a closed forceps into the pupil, allowed the blades of the instrument to separate so as to stretch the pupil to a larger size. This having taken place, I withdrew the forceps, and saw the dilated pupil close in to its former width, a contraction which, of course, in a dead eye, could have been due only to the elasticity of the iris. That elasticity operates also in bringing the pupil from a contracted state to the medium size, may be inferred from the fact that the pupil is often contracted immediately after death, but by-and-by, when the circular fibres relax, dilates to the medium size.

The contractile power of the circular fibres of the iris, by which the pupil is contracted, is under the government of the nerve of the third pair, whilst the contractile power of the radiating fibres, by the action of which the pupil is dilated, is under the government of nervous fibres derived from the sympathetic in the neck. The nervous fibres in question being received by the sympathetic, on the one hand, from the spinal marrow through the hypoglossal nerve, and the anterior roots of the two last cervical and two or three uppermost dorsal spinal nerves, and transmitted from it, on the other hand, to the ciliary nerves through the medium of the ophthalmic branch of the fifth, and its connections with the carotid plexus.

When the whole nerve of the third pair is paralysed, there is dilatation of the pupil to a medium degree, from paralysis of the circular fibres of the iris permitting, 1st, of the operation of the elasticity of the iris; and 2nd, of unrestrained action of the radiating fibres. Besides this effect on the pupil, there are, ptosis, or falling down of the upper eyelid in consequence of paralysis of the levator palpebræ, permitting of unrestrained action of the orbicularis palpebrarum, and a disposition of the eye to turn outwards, in consequence of paralysis of the internal rectus, in common with other muscles supplied by the third nerve, permitting unrestrained action of the external rectus. (Figs. 1 and 2, pp. 6 and 7.)

When dilatation of the pupil occurs, unaccompanied by ptosis and incapacity to turn the eye except outwards and a little downwards, it is owing to paralysis of that branch only of the nerve of the third pair, which goes to the lenticular ganglion.

When the sphincter pupillæ is paralysed, the pupil is not always immoveably dilated. It is still capable of becoming more dilated by the increased action of the radiating fibres and on their relaxation coming back to a middle state by virtue of the elasticity of the iris.

Thus we not unfrequently meet with cases in which the pupil cannot contract beyond the medium size—the size presented when the iris is in a state of complete relaxation. This incapacity to contract must depend on paralysis, or, at least, much impaired power of the circular fibres. In such a case, when the eye after being darkened was suddenly opened to the light, the pupil, which had become dilated, tended to contract, but did not do so beyond, or much beyond, the middle size. After which although still exposed to the light, it again dilated, but only to a slight extent: the antagonism of the elasticity of the iris being sufficient to restrain the passive action of the radiating fibres. Something analogous has often appeared to me to be the case in general paralysis of the nerve of the third pair, in which, also, in consequence of the paralysis of the internal rectus, there is, with the inability to turn the eyeball inwards, a disposition to eversion of the eyeball towards the temporal side, rather than any marked eversion when the patient tries to look forward.

In agreement with M. Bernard, M. Budge has found that after section of the oculo-motor nerve in an animal, full dilatation of the pupil does not take place, but that this effect is produced by belladonna as usual.

By cutting the sympathetic in the neck in dogs and rabbits, contraction of the pupil takes place, in consequence of the radiating fibres of the iris being thereby deprived of their supply of nervous influence and paralyzed, whilst the circular fibres of the iris continue in a state of unrestrained contraction. But it is to be observed that as a first effect of the section of the sympathetic, dilatation of the pupil may occur in consequence of the irritation of the nervous fibres, excited by the section at the moment. Besides paralysis of the radiating fibres of the iris and consequent contraction of the pupil, paralysis and dilatation of the walls of the arteries of the eye and corresponding side of the head, is produced. The consequence of which is one form of inflammatory congestion of those parts.

Irritation of the upper segment of the divided nerve excites dilatation of the pupil and constriction of the dilated arteries of the head and eye.

This effect of irritation of the sympathetic is well observed in the ear of the rabbit. See above (p. 146).

The motions of the pupil are involuntary. The power of moving the pupil by an act of the will, which some persons appear to possess, is owing, not to a direct voluntary power they have over the iris, but to the circumstance that they can readily exert the voluntary power of directing the eyes and adjusting them according to the distance of the objects looked at—an action which calls forth consensual movements of the pupil.

It is not by directly exciting the iris, that light calls forth contraction of the pupil, but by exciting the retina and optic nerve, and thence determining reflex action through the brain to the nerve of the third pair. Hence, when the retina is insensible, or cut off by section of the optic nerve from its connection with the brain, or when the nerve of the third pair is cut off by section from its connection with the brain, the pupil is not influenced by light, but remains fixed in a dilated state. It is, however, to be observed that if an eye, cut out of a living animal, be exposed to light, the pupil is found still to contract somewhat under the stimulus as long as irritability remains. In like manner, in an eyeball after excision, atropia excites dilatation, and Calabar bean, contraction of the pupil, showing that the muscular fibres of the iris are in part under the control of ganglionic centres in the interior of the eye.

When one eye only is exposed to the light, both pupils nevertheless contract, though in a less degree than when they are both exposed to the action of the light at the same time.

This sympathy between the two irides, manifested by motion of both pupils, though one eye only be exposed to variations of light, is explicable by the fact that the optic nerves have each a root in both sides of the brain, and may therefore each be connected in the manner above explained with both oculo-motor nerves.

In some cases of amaurotic blindness, the motions of the pupil under the influence of light are natural. This is explained by supposing that the morbid condition on which the blindness depends, involves only the part of the brain which is the seat of visual perception, and that it is in front of this part of the brain that that condition of structure exists through which reflexion takes place, from the optic on the oculo-motor nerve.

In most cases of amaurosis, motion of the pupil is not excited by the light. If, in a case of this kind, one eye only be affected, the pupil remains fixed, so long as the sound eye is covered, but as soon as the latter is exposed to the light, and motion of its pupil thereby excited, motion of the pupil of the amaurotic eye is generally, though not always, likewise excited.

In cases of mydriasis, but especially of amaurosis, in which the pupil moves in concert with that of the opposite sound eye,—there is no reason for supposing that the third pair is at all affected. The dilatation of the pupil is most probably owing to spasmodic contraction of the radiating fibres of the iris overpowering the action of the circular ones.

If this be so, the contraction of the radiating fibres may be supposed to be owing, in the amaurotic cases, to reflex action of the nerves on which the contractile power of the radiating fibres depends, called forth by the insensible state of the retina, in a manner analogous to that in which the absence of the excitement by light of the healthy retina calls forth dilatation of the pupil, whilst, in consequence of the same insensible state of the retina, reflex action of the nerves on which the contractile power of the circular fibres depends, is no longer called forth by the stimulus of light; but in the cases of fixed dilatation of the pupil, in which the retina is quite sensible (mydriasis, properly so called), the mode in which the excitement is communicated to the nerves supplying the radiating fibres of the iris must be different. The remote causes are blows on the eye and head, gastric irritation, rheumatism, &c.

Persistent contraction of the pupil, apparently in consequence of spasmodic action of the circular fibres of the iris, occurs in some cases of amaurosis (erethitic cases). The spasmodic action appears to be kept up by the irritable state of the retina, exciting reflex action of the nerves of the third pair, in a manner similar, except in degree, to what occurs in ordinary circumstances by the action of light. In some cases, the spasmodic action appears to be occasioned by irritation of the branches of the ophthalmic of the fifth pair exciting reflex action of the oculo-motor.

1st.—*Action of Mydriatics on the pupil.*

The aqueous humour of a rabbit, into whose eye a solution of atropia had been repeatedly dropped, being evacuated, collected, and dropped into the eye of a dog, was found by Dr. von Graefe to produce dilatation of the pupil in the latter animal. This shows that a solution of atropia dropped into the eye makes its way by endosmose into the interior.

It would appear, therefore, that it is a direct local action of the atropia on the radiating muscular fibres of the iris, or what is as likely, on the sympathetic nerve cells or fibres in the iris, which causes the dilatation of the pupil.

It is, however, to be remembered that dilatation of the pupil is produced by the internal administration of belladonna, and by its application to the skin at some distance from the eye. Direct action on the iris is, therefore, not a *sine qua non.*

Seeing that the state of relaxation of the iris, is that in which the pupil is neither much contracted nor much dilated, and that contraction and dilatation of the pupil are manifestations of an active state, the former of the circular, the latter of the radiating fibres of the iris, it is to be inferred, that the action of belladonna, in producing dilatation of the pupil, consists in calling forth, through the medium of the ganglionic system, the contraction of the radiating fibres. These fibres, it is to be remarked, are different from the circular fibres, immediately under the influence of the ganglionic system.

The action of belladonna in dilating the pupil is analogous to that which I have found it to possess, of determining constriction of the small arteries of the frog's web: their circular fibres being, like the radiating fibres of the iris, under the influence of the ganglionic system (p. 141).

An opinion, many years ago expressed by Professor Weber, of Leipsig, that belladonna acts by paralysing the circular fibres, and at the same time exciting the radiating ones, has lately been revived by Biffi, Cramer, and De Ruiter. This, it will be observed, is merely saying that the two sets of fibres are antagonists, and that when one set is excited the other is relaxed. This opinion, therefore, virtually is, that belladonna excites to contraction the radiating fibres of the iris.

In explanation of the mode of action of mydriatics, it is not necessary to assume, then, that the circular muscular fibres or sphincter pupillæ becomes paralysed. In paralysis of the sphincter the pupil falls into the middle state by virtue of the elasticity of the iris, or at the most, somewhat dilated by the unrestrained action of the radiating fibres, but not to the full extent of their action. This is shown by the fact, first pointed out by Professor Ruete of Leipsig, that, in complete paralysis of the oculo-motor nerve, the pupil admits of being very much more dilated by the action of atropia; and also by the fact, above mentioned, that after section of the nerve of the third pair, belladonna still acts as usual.

In cases of iritis, in which exuded lymph has formed bands of adhesion between the pupillary margin of the iris and the capsule of the lens, we see that when the inflammation of the iris subsides, and belladonna comes to exert its full influence, the tearing of the bands of adhesion by the dilatation of the pupil is a manifestation of force exerted by the contraction of the radiating fibres, which strikes one as being the result of active contraction, rather than the result of the mere passive action of muscular fibres freed from the opposition of their antagonist.

After section of the sympathetic in the neck in rabbits on one side, the pupil on that side is not at first so fully dilated by atropia as on the other side.

In reference to this it is to be remarked, that when the iris is in a state of congestion or inflammation, the pupil tends to contract, and yields incompletely to the influence of belladonna. Now, I have no doubt that the iris is in a state of congestion after section of the sympathetic in the neck as well as the conjunctiva, and other parts of the side of the head; and that there is on that account a greater tendency to contraction of the pupil than is merely the result of the unrestrained action of the circular fibres permitted by the paralysis of the radiating ones. This, I believe, may be one cause of the imperfect dilatation of the pupil in such experiments as those I am speaking of. The contraction of the pupil in cases of tumours pressing on the sympathetic in the neck is also, no doubt, in part owing to the coincident congestion of the iris.

2nd.—*Action of myotics on the pupil.*

Under the action of irritating applications to the conjunctiva, the pupil becomes contracted for the time, but such action on the pupil is not the counterpart of that exerted by belladonna.

The only known agent which causes contraction of the pupil, as belladonna causes dilatation of it, is the Calabar bean.

It is applied to the eye, as above mentioned, in the form of a fluid extract, one drop of which is equal to a grain of the bean, or by means of gelatine impregnated with it in such a proportion that a piece one-fifth of an inch square put into the lower palpebral sinus, and left to dissolve there, is sufficient to produce the effect (p. 83).

Too strong an application of the Calabar bean causes severe pain for some time.

The fluid extract being dropped into the eye, as the solution of atropia is, the pupil begins to contract in five or six minutes, and goes on to contract for about half an hour. The contraction of the pupil from the Calabar bean, which is greater than that excited by the strongest action of light, does not continue so long as the dilatation of the pupil from atropia. After the subsidence of the contraction, the pupil becomes rather dilated.

In mydriasis from paralysis of the oculo-motor nerve, the Calabar bean excites myosis or contraction of the pupil.

In mydriasis from a weak solution of atropia, the Calabar bean excites contraction of the pupil, but when the action of the latter subsides, the pupil again falls under the influence of the atropia previously applied; the dilating action of which had been for the time overcome by the stronger contracting effect of the Calabar bean,—not actually neutralised.

Calabar bean may thus be used to counteract the effects of atropia which may have been used to obtain dilatation of the pupil for exploration of the interior of the eye.

As dilatation of the pupil is a principal symptom of the general action of belladonna on the system, so contraction of the pupil was, in 1856, shown by Dr. Van Hasselt to be a principal symptom of the general action of the Calabar bean on the system. To Dr. Thomas Fraser we are indebted for the discovery that its direct application to the eye produces the same effect, and to Dr. D. A. Robertson for having directed attention to its action on the adjustment of the eye for near sight.

When locally applied, the solution of the Calabar bean will make its way, by diffusion, into the interior of the eye, like the solution of atropia.

Seeing that the state of relaxation of the iris is that in which the pupil is neither much contracted nor much dilated, and that contraction and dilatation of the pupil are manifestations of an active state,—the former of the circular, the latter of the radiating fibres of the iris,—it is to be inferred that the action of the Calabar bean in producing contraction of the pupil consists in calling forth the contraction of the circular fibres or sphincter pupillæ, either by direct action on them, or through the medium of the nerve of the third pair, which governs their contractions.

In explanation of the mode of action of the Calabar bean, it is not necessary to assume that the radiating muscular fibres of the iris become paralysed.

It has, indeed, been found that the Calabar bean always excited greater contraction of the pupil in dogs and rabbits after section of the sympathetic in the neck; but, on the other hand, irritation of the sympathetic excited the dilatation of the pupil though under the influence of the Calabar bean.

3rd.—*Action of atropia and Calabar bean on the adjustment of the eye.*

As belladonna, besides exciting dilatation of the pupil, excites an extreme state of adjustment of the eye for distant sight, so the Calabar bean, besides exciting contraction of the pupil, excites an extreme state of adjustment of the eye for near sight.

In cases of irideremia, or congenital absence of the iris, the adjustment of the eye for distant sight is still excited by atropia, and for near sight by the Calabar bean.

Whilst dilatation of the pupil by atropia is evidently owing to contraction of the radiating fibres of the iris, the coincident adjustment for distant vision is as evidently owing to contraction of muscular fibres subservient to that purpose. So, also, whilst contraction of the pupil by the Calabar bean is evidently owing to contraction of the sphincter pupillæ, the coincident adjustment for near vision is as evidently owing to contraction of muscular fibres subservient to that action.

MYOSIS AND MYDRIASIS.

The name *myosis* is given to an unnaturally contracted,—that of *mydriasis* to an unnaturally dilated, state of the pupil, persisting in opposition to the influences to which the pupil is ordinarily obedient, and independently of morbid adhesions, or other organic change of the iris.

1st.—*Myosis.*

Myosis may occur uncomplicated with defective sensibility of the retina, but as mere contraction of the pupil does not disturb vision much, except in weak light, it does not usually come under the notice of the practitioner.

Myosis, when it comes under the notice of the practitioner, is generally attended by defective vision, the myosis and the defective vision being equally symptoms of a morbid condition of the retina.

In those cases in which vision is not impaired, myosis appears to be the result of the habitual contraction of the pupil, induced by constant employment of the eyes on minute and brilliant objects, and is, therefore, frequently met with in jewellers, watchmakers, engravers, &c. The circular fibres, from being at first dynamically and temporarily, would seem, at last, to become organically and permanently, contracted.

In the other cases it appears to be owing to the tonic contraction of the sphincter fibres, in consequence of reflex nervous action, excited by the state of the retina, differing from what is the case in ordinary circumstances only by being long kept up.

Treatment.—In cases of myosis of the first kind, belladonna has not much effect on the pupil; and in cases of the second kind, when it does produce some degree of dilatation, vision is not improved; but, on the contrary, disturbed by it. The principles which should regulate the treatment of such cases, are the same as those laid down for the cases comprehended under Amaurosis.

In one such case I performed iridectomy, with a result which was satisfactory to the patient.

2nd.—*Mydriasis.*

Mydriasis, unaccompanied by any other disturbance of vision than is accounted for by the state of the pupil and of the optical adjustment, *viz.*, dazzling, confusion, multiplication, and coloration of objects, especially near

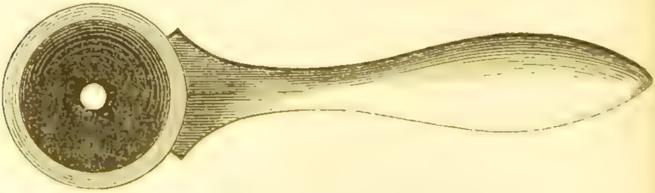

FIG. 122.

objects, in consequence of diminution of the correction of spherical, chromatic, and distantial aberrations, is to be carefully distinguished from the dilatation of the pupil, which is so common a symptom of amaurosis.

That a case is one of simple mydriasis is ascertained if the patient, on looking through an aperture, of less than the ordinary size of the pupil, is able to see objects quite distinctly. A stenopaeic apparatus, or an instrument such as that represented in the above figure (fig. 122), may be kept for the purpose, but an extemporaneous one can be made by piercing a card with a thick pin (p. 69). If the card be blackened on the surface next the eye so much the better. As the mydriasis is accompanied by the state of adjustment for distant objects, vision is improved by convex glasses. The patient sees better in dull light.

Treatment.—The treatment of mydriasis accompanying ptosis and divergence of the eye, as the consequence of paralysis of the oculo-motor nerve, is discussed below under that head. Gastric irritation, or other disordered states (p. 449), of which the mydriasis is likely to be a symptom, should, in any case, be the object of treatment.

The Calabar bean we have seen will excite contraction of the pupil, though its action is too transient to prove of much use. In cerebral mydriasis the Calabar bean has been found of no effect.

REFRACTION BY CONVERGENT LENSES, AND THE ADJUSTMENT OF THE EYE FOR DIFFERENT DISTANCES.

The rays of light from distant objects, though not strictly parallel, are usually assumed to be so.* The focus to which such rays are brought by a convergent lens, is called the *principal focus of the lens.*

If rays do not come from such a distant body as to be parallel, but are more or less divergent, then the focus to which they are brought, is farther off from the lens than its principal focus, *viz.*, at some point between this and infinite distance. The point in question is nearer the principal focus the more distant the body whence the rays emanated, in other words, the more nearly parallel they are; and *vice versâ.*

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* The rays of light from objects beyond the distance of twenty feet are arbitrarily assumed to be parallel. Rays from objects within the distance of twenty feet, divergent.

The point of an object from which any given pencil of divergent rays emanates, is named the *focus of incident rays*, and the focus to which those divergent incident rays are brought by the lens is named the *focus of refracted rays*. These two foci, the focus of incident rays, and the focus of refracted rays, in consequence of the relation between them above pointed out, *viz.*, that when the one is near, the other is distant from the lens, are named *conjugate foci*.

From this it will be perceived, that if the refractive media of the eye were incapable of change, either as regards power, or as regards their relative position to the retina, the rays of light from objects at one particular distance only, would be collected into foci on the retina. (Fig. 123). Rays from objects farther from the eye than that distance would come to foci, before arriving at the retina, and having crossed, would fall on the retina in circles of dissipation (Fig. 124). Rays from objects

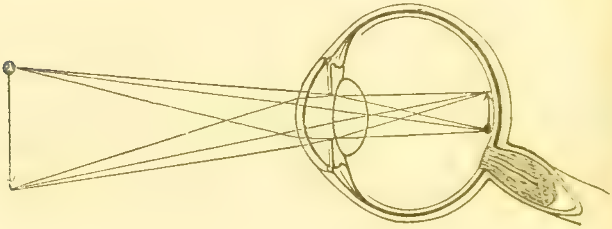

FIG. 123.

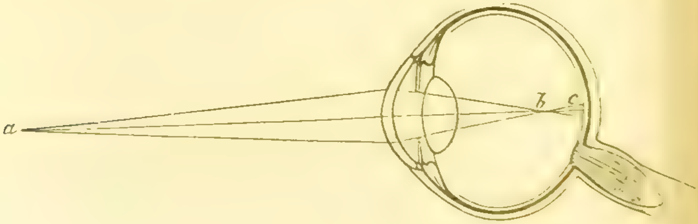

FIG. 124.

a. Focus of incident rays; *b*, focus of refracted rays falling in front of the retina; *c*, the rays impinging on the retina, in a scattered state.

nearer would not come to foci, except behind the retina, on which therefore they would fall likewise in circles of dissipation (Fig. 125).

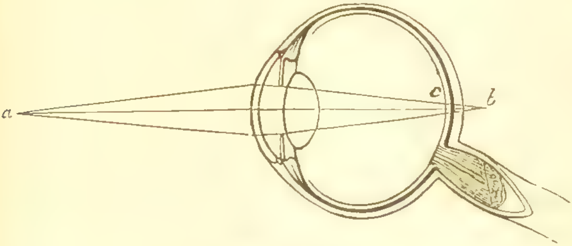

FIG. 125.

a, Focus of incident rays; *b*, focus of refracted rays falling behind the retina; *c*, the rays in a scattered state, as they impinge on the retina.

The result of this would be, that objects could be seen perfectly distinctly only when situated at one particular distance from the eye. But we know that this is not normally the case. We know that objects can be seen *perfectly* distinctly at different distances, within certain limits. Hence the eye must admit of adjustment to different distances, like our optical instruments.

Here the distinction is to be explained between perfect and distinct vision. In perfect vision, the outline, colour, and details of the object appear traced with the utmost accuracy, clearness, and strength; and this we have only when the rays of light are brought accurately to foci on the stratum bacillosum of the retina. In distinct vision, larger objects are seen so well, that they are readily recognised: the title-page of a book, for example, can be easily read, but there is a want of clearness of outline and strength of tint, and small objects or the details of large objects are imperfectly recognised; this is owing to the rays of light not falling on the retina in exact foci, but in small circles of dissipation.

When looking at near objects, the axes of the eyeballs are converged, and the pupils are contracted. When looking at distant objects, the axes of the eyeballs are parallel, and the pupils are dilated; but these variations in the direction of the eyeballs and size of the pupil are merely a concomitant and auxiliary, not an essential condition of adjustment.

With a contracted pupil, or by looking through a small aperture, a presbyopic eye can see near objects, and a myopic eye distant objects, more distinctly. This is owing to the exclusion of the extreme circumferential rays of the cones of light which enter the eye, and the consequent diminution of the circles of dissipation on the retina (p. 70).

1st.—*The changes in the condition of the eye on which adjustment depends:—*

a. For near objects.

It has long been considered probable on theoretical grounds, that adjustment of the eye for different distances depends on a change in the form and position of the crystalline lens. By a slight increase of the convexity of that body, and a slight movement of it forwards, it was calculated that the eye could be adjusted for the vision of near objects; and that by an opposite change, it could be adjusted for distant objects.

The fact that the power of adjustment ceases with the loss of the crystalline lens appeared to corroborate this opinion.

That an increase of the convexity of the anterior surface of the lens does actually take place in adjustment of the eye for the vision of near objects, was originally enunciated by Dr. Thomas Young, and of late years the fact has been established by the observations of Langenbeck, Cramer and Helmholtz. The proof was found by observing the changes which take place in the appearances in respect to *size* and *position* of the image of a candle held before the eye, as reflected by the anterior surface of the lens.

Change of the image in respect to size.—The image reflected by the anterior surface of the lens becomes smaller. That this is as it ought to be, if the anterior surface became more convex, may be demonstrated by comparing the size of the image of a candle as reflected from the surfaces of two glass lenses of different degrees of convexity, when it will be seen that the image reflected from the surface of the more convex lens is the smaller.

Change of the image in respect to position.—The position of the image is changed in such a way as to show that the anterior surface of the lens has approached nearer the cornea.

This approach of the anterior surface of the lens towards the cornea is the result of the increase in convexity only, not of a movement forward of the lens as a whole. By the advance of the anterior surface of the lens, it has been observed that the pupillary margin of the iris, the pupil being at the time contracted, is pushed forward, whilst the ciliary periphery of the iris is retracted.

When the eye is adjusted for the vision of near objects, there is also, according to Helmholtz, a slight increase in the convexity of the posterior surface of the lens.

b. For distant objects.

Besides the fact that the anterior surface of the lens is ess convex and less near the cornea, as shown by the arger size and different position of the reflected image of the candle, when the eye is viewing distant objects, Professor Helmholtz has found, by measurements, made during life by means of his ophthalmometer, that the lens is thinner than it is in the dead eye.

2nd.—*Mechanism by which the changes in the convexity of the lens in adjustment of the eye for different distances is effected.*

Physiologists are now pretty well agreed, that the increase in the convexity of the lens in adjustment of the eye for the vision of near objects, is brought about by muscular contractility, and it is generally believed that the agent is the ciliary muscle, named also *tensor choroideæ*, though its exact mode of action may not be clear.

There is not so much unanimity of opinion in regard to adjustment of the eye for the vision of distant objects; he question being open, whether that is owing merely to he lens, by virtue of its own elasticity and that of its surrounding parts falling back into the form fitted for distant vision, on the cessation of the muscular action by which the accommodation of the eye for near vision was effected, or whether it be not really owing to muscular contraction, causing a flattening of the lens; the real reaxation of adjustment being an intermediate state, just as the real state of relaxation of the iris is that in which the pupil is neither much contracted nor much dilated.

In reference to the mode of action of the ciliary muscle in producing the changes in the convexity of the lens, it is to be premised that the latter body, enclosed in its capsule, possesses a high degree of elasticity, so that it admits of being altered, in respect to its degree of convexity and thickness, by very slight pressure, and on the remission of the pressure, of resuming its original form.

Believing that the adjustment of the eye for vision at a distance depends on muscular contraction as well as adjustment for the vision of near objects, and that the real state of relaxation is that in which there is an intermediate degree of adjustment, I look upon the exterior fibres of the ciliary muscle which run from before backwards, as the agent by which the adjustment for distant vision is effected, and seek in the innermost fibres, which run circularly, for the agent by which adjustment for near vision is effected.

The connection of the ciliary body with the zonule of Zinn is such, that when the circular fibres of the ciliary muscle contract, the zonule of Zinn must be slightly drawn together round the circumference of the lens, like the mouth of a purse. The effect of this would necessarily be, to force the lens forward in the aqueous humour, if it was not that the circumference of that body is, at the same time, drawn back by the peculiar fibres which arise from the posterior margin of the zonule of Zinn, and are inserted into the anterior wall of the capsule near its circumference all round. The consequence is, that the anterior surface of the lens is rendered more convex, without the body, as a whole, being moved forward.

The peculiar fibres which extend from the zonule of Zinn to the capsule of the lens, are endowed with elasticity. They, at the same time, present somewhat the microscopical characters of the sheathed muscular fibre, only they have no distinct transverse markings. To the corona formed by the aggregate of these fibres, the name *orbiculus capsulo-ciliaris* has been given.

In the anatomical introduction to the second edition of Dr. Mackenzie's work on the eye, I remarked that, supposing the lens to be forced forward by some power, the action of the *orbiculus capsulo-ciliaris* would be to press back the circumference of the lens, and so render the anterior surface more convex. That the circumference of the lens is so pressed on, is evident from the indentations observed on it in old eyes.

The existence of the canal of Petit appears to permit of the change in the form of the lens above described to take place more readily.

By the same contraction of the circular fibres of the ciliary muscle, the ciliary periphery of the iris is retracted, while the advancing anterior surface of the lens pushes the pupilliary margin of the iris before it.

If this be the action of the circular fibres of the ciliary muscle, it takes place in concert with that of the circular fibres of the iris which contract the pupil.

The Calabar bean, at the same time that it excites contraction of the pupil, calls forth in the eye the state of adjustment for the vision of near objects. The circular fibres of the ciliary muscle, still supposing them to be the agents of adjustment for the vision of near objects, must thus be excitable by the Calabar bean, as well as the circular fibres of the iris.

The contraction of the circular fibres of the iris ceasing, the pupil falls into a medium state of dilatation, by virtue of the elasticity of the iris, unless contraction of the radiating fibres of the latter supervenes. So also the contraction of the circular fibres of the ciliary muscle ceasing, the adjustment of the eye falls into an intermediate state, which is one of relaxation, by virtue of the elasticity of the lens and parts around it.

I have said that I believe adjustment of the eye for the vision of distant objects to be an active state, as well as adjustment for near objects, and that I look upon the exterior fibres of the ciliary muscle, which, arising from the outer layers of the vitreous fibres in which the membrane of Descemet subdivides at the circumference of the cornea, run backwards, and are inserted into the choroid, as the agent by which that adjustment is effected.

On account of the same connection of the ciliary body with the zonule of Zinn, which subjects the latter to be acted on by the circular fibres of the ciliary muscle in the manner just explained, the exterior fibres of that muscle must effect an opposite action on it, whereby the lens will be subjected, through its connection, with the anterior and posterior walls of the canal of Petit to a pressure tending to flatten it, and to make its anterior surface recede. That the lens is, during the adjustment of the eye for distant vision, actually thinner than it is in the dead eye, is a fact which, as above mentioned, has been ascertained by the ophthalmometric observations of Helmholtz.

Dilatation of the pupil accompanies adjustment of the eye for the vision of distant objects.

If adjustment of the eye for the vision of distant objects be effected by the exterior fibres of the ciliary muscle, as just explained, we see that they act in concert with the radiating fibres of the iris which dilate the pupil.

Atropia, at the same time that it excites dilatation of the pupil, throws the eye into the state of adjustment for the vision of distant objects. It is, therefore, to be inferred that, supposing the exterior fibres of the ciliary muscle to be the agents of adjustment for the vision of distant objects, these fibres must be, like the radiating fibres of the iris, susceptible of the influence of atropia.

The contraction of the radiating fibres of the iris ceasing, the pupil comes back to a medium state of dilatation, by virtue of the elasticity of the iris, unless contraction of the circular fibres immediately supervenes. So also the contraction of the exterior fibres of the ciliary muscle ceasing, the adjustment of the eye comes back to an intermediate state, which is one of relaxation, by virtue of the elasticity of the lens and surrounding parts, unless the muscular action causing adjustment for near objects immediately supervenes.

When contraction of the pupil ceases, it is not necessarily succeeded by great dilatation, nor *vice versâ*. In like manner, when adjustment for near objects ceases, it is not necessarily succeeded by adjustment for distant objects, nor *vice versâ*.

Belladonna or atropia in exciting dilatation of the pupil, it has been above contended, is not to be supposed to paralyse the circular fibres at the same time that it excites the radiating fibres to contract, nor in causing adjustment for distant objects to paralyse the circular fibres of the ciliary muscle, at the same time that it excites the exterior fibres to contract.

So also, the Calabar bean in exciting contraction of the pupil, is not to be supposed to paralyse the radiating fibres of the iris at the same time that it excites the circular fibres to contract; nor in causing adjustment of the eye for near objects to paralyse the exterior fibres of the ciliary muscle, at the same time that it excites the circular fibres to contract.

It would be wrong to say that when a muscle contracts, its antagonist first becomes paralysed. The antagonist merely ceases to act, but remains ready to come into action again as soon as its contraction is excited by the usual stimuli.

I have elsewhere, long ago, pointed out that on applying a solution of atropia to the web of the frog under the microscope the small arteries are seen to become gradually constricted (p. 144). This can of course be the effect only of contraction of the circular muscular fibres of the arterial wall. That contraction, therefore, we are entitled to say has been excited by the atropia. As there are no muscular fibres, the action of which could be to oppose the circular fibres and keep the arteries dilated, there can of course be no complication of the question as to the mode of action of the atropia, with a supposed paralysis.

It is known that the radiating muscular fibres of the iris and the circular muscular fibres of the walls of arteries are both under the control of the sympathetic nerve. By section of the sympathetic in the neck, for instance, the arteries of the eye and other parts of the head, to which branches from that part of the sympathetic are distributed, become dilated from paralysis of their circular muscular fibres, and the pupil becomes of the middle size or even more or less contracted in consequence of paralysis of the radiating fibres of the iris, which are under the control also of branches from the part of the sympathetic named.

Again, it has been shown by Dr. Donders of Utrecht, from experiments on white rabbits, that the blood vessels of the iris on irritation of the sympathetic nerve in the neck, become constricted while the pupil dilates. In other words, the irritation of the sympathetic in the neck excites to contraction the circular muscular fibres of the arteries of the iris and the radiating muscular fibres of the iris itself.

That the adjustment of the eye for its furthest point of vision is a passive state into which it falls by elasticity, on the cessation of the muscular contraction by which the adjustment for near distances is effected, is an opinion which, hitherto tacitly admitted, has found in Dr. Donders of Utrecht a most able advocate.

He founds his arguments mainly on the assumption that belladonna produces its effect of throwing the eye into the state of adjustment for distant vision, and suspending the power of adjustment for near vision by paralysing the ciliary muscle which, including both its circular and exterior fibres, he considers to be the special agent by which the adjustment for near objects is effected, and thus allowing the elasticity of the lens and its connecting structures to bring it into the shape and position it would assume sometime after death.

It has, however, been above shown that it is very certain that atropia causes dilatation of the pupil, not by paralysing the circular muscular fibres of the iris and so giving scope to an unrestrained action of the radiating fibres, but by directly exciting to contraction the radiating fibres themselves.

This being so, I cannot admit that atropia acts by paralysing the muscular fibres which are the agent of adjustment for near objects. I maintain rather that it produces the effect of bringing the eye into a state of adjustment for distant objects by exciting contraction of the muscular fibres which are the agents of adjustment for distant vision.

Many years ago, Dr. Wells, in describing his experiments on the action of belladonna, says, that not only was the accommodation for near objects wholly suspended, but that the furthest point of vision somewhat receded. My own observations are to the same effect. Now, what does this mean but that the muscular adjustment for extreme distances was excited in a strong degree by the belladonna.

But to return to Dr. Donders. This ophthalmologist adduces as another proof that the state of adjustment for distant objects is a passive state, the fact that, in cases of paralysis of the oculo-motor nerve in which the pupil is more or less dilated, the adjustment for near objects is not unfrequently lost, and that the eye is in the condition of refraction corresponding to the furthest point originally proper to the eye.

This is so in some cases in which in consequence of paralysis of the muscular structure on which adjustment for near objects depends, those which actively effect adjustment for distant objects have taken on an unrestrained contraction; just as, in some cases of paralysis of the oculo-motor nerve also, the radiating fibres of the iris take on an unrestrained action and the pupil is dilated to a great width.

Most generally, however, the pupil remains in or about the middle state, being brought thereto, on the suspension of the action of the circular fibres, by the elasticity of the iris, and it only becomes, as above shown, fully dilated on the application of belladonna or atropia. In such cases, the eye is not reduced to its state of lowest refraction until then.

3rd.—*Emmetropia and Ametropia.*

Some persons are able to see distinctly now at very great distances, now near at hand, while others cannot see well at any great distance, though they see distinctly at various short distances.

In the first case, the power of the refractive media of the eyes is in such correspondence with the distance at which the retina is spread out behind, that the changes in the convexity of the lens effected by the adjusting apparatus are sufficient to enable the eye now to bring parallel rays,—now variously divergent rays, to foci on the retina. Such eyes can, therefore, see both the most distant objects and objects at various degrees of proximity—as near, perhaps, as four inches in childhood, but usually not nearer than about six or eight inches in adult age.

In the second case, the power of the refractive media of the eyes is not in such nice correspondence with the distance at which the retina is spread out behind. The antero-posterior axis of the eyeball, in such cases, is usually somewhat more elongated than natural, so that the retina lies at a greater distance behind the lens. The consequence is that, though the adjusting apparatus may be normal, parallel rays, or the rays from distant objects are brought to foci before reaching the retina (Fig. 127); so that, after crossing, they diverge and fall in circles of dissipation on that membrane, yielding an ill-defined image. The focus of divergent rays or rays from near objects being at a greater distance behind the refractive media will, in such eyes, impinge on the retina. And, by the variations in the convexity of the lens effected by the adjusting apparatus, the eyes are enabled to bring rays to foci on the retina, now of one degree of divergence, now of another degree, so that, as mentioned, the persons can see distinctly at various short distances. The medium distance being proportionate to the refractive power,—the nearest distance to the near adjusting power,—and the furthest distance to the far adjusting power.

To see objects at a distance distinctly, such persons require *concave* glasses of suitable power in order to give the necessary degree of divergence to the rays on entering the eyes.

We have seen that Professor Donders admits an active or muscular adjustment only for seeing near objects. He considers the adjustment of the eye for the vision of distant objects to be a passive state or state of relaxation into which the lens, by virtue of its own elasticity and that of its connections, falls on the cessation of the action of the muscular fibres subservient to the adjustment for near sight.

We have also seen that Professor Donders assumes that the action of atropia on the eye is to paralyze the muscular fibres subservient to the adjustment of the eye for near sight as well as the sphincter pupillæ, so that the eye is thrown into the state of relaxation as regards adjustment.

He accordingly measures the principal focus of an eye by the refractive condition of it while under the influence of atropia, or in its assumed passive state or state of relaxation.

Thus, if he finds that an eye under the full influence of atropia can see distinctly at a distance, in other words can bring parallel rays to a focus on the retina, he takes that eye as a model or standard eye and calls it EMMETROPIC (from ἔμμετρος, measured, and ὤψ, eye), and its refractive condition EMMETROPIA. (Fig. 126.)

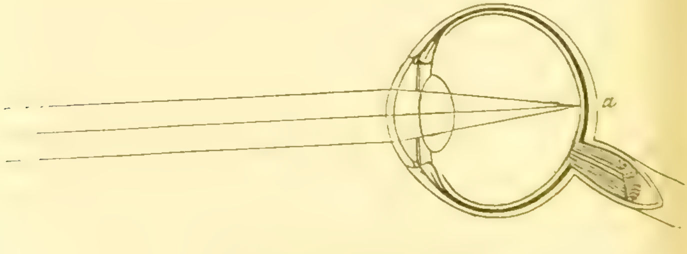

Fig. 126. Emmetropic eye.

If, on the contrary, he finds that an eye under the influence of atropia cannot see at any great distance, in other words, that the principal focus (or the focus to which parallel rays are brought) falls in front of the retina, he calls it BRACHYMETROPIC (from βραχὺς, short—μέτρον, measure, and ὤψ, eye), as its limit of distinct vision is within or short of his standard of measurement, whilst BRACHYMETROPIA is the name by which he designates its refractive condition. (Fig. 127.)

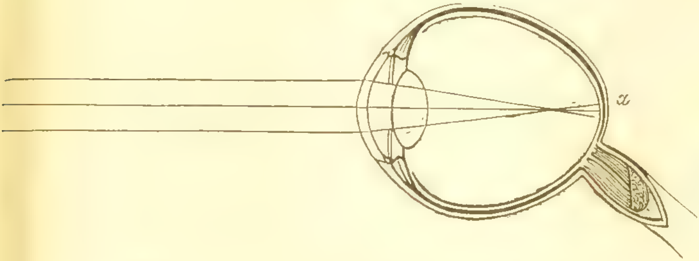

FIG. 127. Brachymetropic or Myopic eye.

Brachymetropia, as here defined, is identical with MYOPIA, and as the latter name is well known, and in common use in the sense referred to, Professor Donders does not propose to supersede it by the name brachymetropia. This latter name he coined merely to contrast with that of HYPERMETROPIA to be noticed below.

I do not concur in the opinion of Donders that adjustment of the eye is rendered inactive or paralyzed—thrown into the same state as in a dead eye—by the action of atropia;—nor that the adjustment for the furthest point of distinct vision is a state of paralysis or inaction.

Atropia, on the contrary, I have shown, excites to action muscular structures so as to change the eye from a *passive medium* state, to an active state of adjustment for the furthest point of distinct vision.

According to this view, the passive state of an eye, which Donders would call emmetropic, is not that in which it is capable of bringing parallel rays to a focus, but is that in which it is capable of bringing slightly divergent rays to a focus. It is by the action of the muscular fibres which, like the radiating fibres of the iris are under the control of atropia, that such an eye is so adjusted as to be capable of bringing parallel rays to a focus.

Though thus differing from Professor Donders, I can use the name *emmetropia* to the same cases as he does. Our interpretation of their nature only differs. The emmetropic eye, according to my view of it, is theoretically a more perfect instrument than it is, according to Professor Donders' view of it. In its state of relaxation it is fitted for the vision of surrounding objects at ordinary distances, and when the attention is directed to remote objects, the adjustment for parallel rays, or rays more or less nearly parallel, is called into requisition, whilst when near and minute objects come under examination the adjustment for more or less divergent rays takes place. According to Professor Donders' view of the matter, the adjusting apparatus is thrown out of gear altogether, when distant objects are looked at, so that a very great strain would be put upon it when near objects are examined.

In like manner, in brachymetropia or myopia, the state of relaxation of the adjustment of the eye in my view is not that fitted for the furthest point, at which the eye is capable of seeing, but is that fitted for a nearer point, the adjustment for the furthest point being, as well as that for the nearest point, an active state.

In some eyes in their passive state or state of relaxation of their adjustment, and still more when under the influence of atropia, even parallel rays are not brought to a focus on the retina, but tend to come to foci only behind that membrane, on which therefore they impinge in circles of dissipation and consequently make an indistinct impression.

In such cases the power of the refractive media of the eyes is not in correspondence with the distance at which the retina is spread out behind. The antero-posterior axis of the eyeball is shorter than normal, so that the retina lies at a shorter distance behind the lens. The consequence

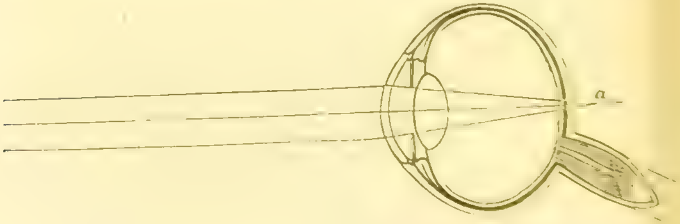

FIG. 128. Hypermetropic eye.

is that, without an effort of the adjusting apparatus for near distances, even distant objects cannot be seen, *i.e.*, even parallel rays cannot be brought to foci on the retina. The principal focus falls behind the retina. (Fig. 128.)

Such eyes, Professor Donders calls HYPERMETROPIC (from *υπέρμετρος*, beyond measure, and ὤψ, eye), and their refractive condition, HYPERMETROPIA.*

To see even a distant object distinctly, therefore, a *convex* glass of suitable power is required in order to bring the rays from their parallel to a convergent state before entering the eye, so that the refractive power of the eye may be assisted in bringing them more quickly to foci, in accordance with the short distance at which the retina is spread out behind.

Anatomico-optical conformation of the eye in emmetropia, myopia, and hypermetropia.—In the emmetropic eye (Fig. 126, p. 466), the axis is not so long as in the myopic eye (Fig. 127, p. 467), but longer than in the hypermetropic eye (Fig. 128, p. 468). Thus it is, that, supposing the refractive power the same in all and that the retina in the emmetropic eye is in the principal focus, the rays of light in the myopic eye come to a focus in front of the retina; whilst in the hypermetropic eye, they come to a focus behind.

In the myopic eye, the lens usually lies further behind the cornea. This should, therefore, cause the focus to fall further back towards the retina, but, notwithstanding this, in consequence of the very great length of the axis, the rays still come to a focus before reaching the retina.

In the hypermetropic eye, on the other hand, the lens usually lies nearer the cornea. This should, therefore, cause the focus to fall further forward, nearer the cornea, but, notwithstanding this, in consequence of the shortness of the axis, the rays still fall on the retina, before they can come to a focus.

The cornea in myopia is often more convex than in emmetropia; and in hypermetropia less convex and smaller. What difference, however, in this respect, there may be, is, according to Dr. Donders, not so great in reality as in appearance. In myopia the cornea looks more prominent in consequence of the greater depth of the anterior chamber and greater prominence of the eyeball generally. In hypermetropia, on the contrary, the cornea looks less prominent in consequence of the small depth of the anterior chamber and the little prominence of the eyeball generally.

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* The name *ametropic* (from *ἄμετρος*, without measure, and ὤψ, eye), Donders applies to eyes not *emmetropic*, that is, generically to both *brachymetropic* and *hypermetropic* eyes. *Ametropia*, as a negative state, is thus opposed to *Emmetropia*, as a positive state.

4th.—*Range of adjustment.*

If an emmetropic person has lost the power of adjusting his eyes for the vision of near objects, and it is only at a distance that he can see distinctly—in other words, if his eyes are capable of bringing parallel rays only to a focus on the retina, the focal power of the convex glasses which he will require to enable him to see to read, will of course be such as will render the rays radiating from the distance at which he desires to read—say ten inches from the eye—parallel before entering it. The focal length of such glasses will be ten inches.

If a person is not so very far-sighted, but can see objects distinctly at twenty-four inches' distance, for example, the power of the convex glasses which he will require to enable him to see to do any fine work at, say ten inches' distance, will be such, of course, as will reduce the divergence of the rays radiating from a point at that distance from the eye to the degree of divergence of rays radiating from a point at the distance of twenty-four inches. The focal length of such glasses may be determined by multiplying the two distances twenty-four and ten together, and dividing the product 240 by the difference between them, viz., fourteen. The quotient, seventeen (omitting the fraction), is the focal length in inches of the glasses required.

Suppose now, a person has the power of adjusting his eyes so as to be able to see distinctly at any distance from ten inches to infinite distance, his range of adjustment may be expressed by the power of the convex lens required to refract the rays radiating from ten inches' distance, so that they may be rendered parallel, viz., ten inches focus.

But suppose a person can see distinctly only at any distance from eight to twenty-four inches, his range of adjustment will be expressed by the power of the lens required to refract the rays radiating from eight inches' distance, so that they may be brought to the degree of divergence of rays radiating from a point at the distance of twenty-four inches, viz., twelve inches focus.

5th.—*Relation between the direction of the visual axes or lines and the adjustment of the eyes.*

Generally speaking, the eyes become adjusted for the distance of the objects to which their axes are directed. When we look at distant objects, the visual lines are directed in a parallel manner. At the same time, the pupils dilate, and, supposing the eyes emmetropic, they are adjusted for parallel rays—that is, for the distance at which the objects are. When on the contrary, we look at near objects, we converge the visual lines of the eyeballs on them. At the same time the pupils contract, and adjustment for the degree of divergence of the rays coming from the objects takes place, *i.e.*, for the distance at which the objects are.

In short:—

The condition of the eyes for adjustment for the *far point* of vision is parallelism of their axes.

The condition of the eyes for adjustment for the *near point* of vision is convergence of their axes.

Parallelism of the axes of the eyes prevents adjustment for the near point;—while convergence of their axes prevents adjustment for the *far point.*

This connection between the direction of the eyes and their adjustment is not, however, absolute, any more than dilatation or contraction of the pupils is so. Thus, if while looking at an object at the distance of twelve inches, weak convex or concave glasses be put before the eyes, they will become so altered in their adjustment as to overcome the action of the glasses, and will thus continue to see the object distinctly with the same degree of convergence.

In hypermetropia, adjustment for a near point is sometimes effected only by excessive convergence running into squint. See below.

6th.—*Myopia, or near-sightedness.*

When objects can be seen perfectly distinctly only at so short a distance that the rays of light received from them are very divergent, the eyes are said to be *myopic*, and the state of vision is designated *myopia.*

In the slighter degrees of myopia, which are common enough, the indistinctness with which objects at a distance are seen not being very incommoding, the person may remain unconscious of his defect until he happens, by chance perhaps, to look through a shallow concave glass, and discovers that he sees objects at some distance with unaccustomed clearness and definition. In such a case the person will probably find, that without concaves he can see distinctly at no greater distance than two, three, or four feet, whilst at the distance of twelve or twenty feet he sees very indistinctly.

In trying to view distant objects, the near-sighted person half closes his eyelids. By this means the extreme circumferential rays of the cones of light entering the eyes are cut off, especially above and below; the effect of which is that horizontal lines are seen better defined.

The name of myopia for near-sightedness is derived from this habit of half closing their eyelids which near-sighted people acquire.

Myopia might be owing either to excessive refractive power of the transparent media of the eye, or to the distance of the retina behind the crystalline lens being abnormally great; so that, in either case, the rays of light from distant objects, that is, rays of light parallel or but slightly divergent, would be brought to foci before impinging on the retina, would cross and be in a state of dissipation when they did impinge on that nervous membrane. The consequence would thus be, the projection of ill-defined images of the distant objects. (Fig. 127, p. 467.)

In cases of prominent cornea from corneitis, and in conical cornea, there is myopia from excessive refractive power of the eye, but there is indistinctness of sight in addition; in the former case, from nebulosity or opacity of the cornea, and in the latter case from the abnormal irregular astigmatism.

Myopia from spasm of the near adjusting muscular apparatus of the eye, maintaining increased refraction, may be met with, but only as a temporary affection in young persons.

Too great a distance of the retina behind the crystalline lens, from preternatural elongation of the antero-posterior axis of the eyeball, however, we have seen, is the condition on which myopia, or near-sightedness, most commonly depends. In cases of prominence of the anterior segment of the eye from *sclerotico-kyklitis* or inflammation of the ciliary body and corresponding part of the sclerotica adjacent to the cornea (p. 229), there is elongation of the antero-posterior axis of the eyeball with near-sightedness, but the preternatural elongation of the antero-posterior axis of the eyeball, occasioning too great a distance of the retina behind the crystalline lens, to which myopia is most commonly owing, is the result of posterior sclerotic staphyloma (p. 298).

In a case of myopia, or near-sightedness, the object, when near, is distinctly seen, because the rays from it, which enter the eyes, being more divergent than when it was distant, are not so soon brought to foci by the same amount of refractive power; in other words, the different points of the object, as so many foci of incident rays, and the foci to which those rays are brought in the interior of the eye by the refractive media, are *conjugate foci*, and, accordingly, when the foci of incident rays are brought nearer the refractive media, the foci of refracted rays recede from them, and, therefore, fall on the retina.

In myopia, the power of adjusting the eye is still retained, and fails only, as usual, with the advance of life. The range of adjustment may be as great as in the emmetropic eye, only it comprehends nearer distances. Thus, by the exercise of its adjustment, an average myopic eye may see as near as from two to four inches, and as far off as from six to twelve or eighteen inches. With one pair of concaves fitted to correct the effects of the myopic conformation of the eyes, the person, still possessing the power of adjustment, is often able to see distinctly both near and distant objects, like an emmetropic person.

On failure of the adjusting power with the advance of life, a near-sighted person, whose eyes are otherwise fairly sound, ceases to see well so very near as he used to do. He ceases also, perhaps, to see well so far off. He continues, however, to see well at an intermediate distance. And if that distance happens to be about eight or en inches, he is not much incommoded so far as reading and writing are concerned.

The pupil in such cases being usually smaller than it is n early life, the extreme circumferential rays from objects out of focus are thereby cut off, and the sight of those objects in consequence of the diminution of the circles of dissipation on the retina, rendered less indistinct.

The advantage of the myopic over the emmetropic eye is, that though the former ceases to see very near objects well, it continues to see surrounding objects distinctly enough. Many persons are thus not aware that they are myopic until on trial it is discovered that they cannot see large print at the distance of twenty feet without concaves.

To be able to write and read without spectacles by candle-light after fifty, indicates myopia.

Peculiarities of the vision of myopic, or near-sighted, people. —Very near-sighted people do not regard fixedly the face of the person with whom they are in conversation, not being able to distinguish their features properly. Their manner and gait also are sometimes characterised by what appears a certain degree of awkwardness. In reading, they hold the book obliquely, as they use one eye only, not being able to converge the two eyes so much as would be necessary for binocular vision at so short a distance.

With good adjustment, myopic persons see small objects more distinctly than other people, because, from their nearness the objects are viewed under a larger visual angle.

They see them also with a weaker light, because the objects being near, a greater quantity of rays from them arrive at the eye. Hence, they can read small print with a weak light.

But they can also see more distinctly, and somewhat further off by a strong light than by a weaker one, because the pupil is contracted by the strong light, and the extreme circumferential rays of light thereby excluded. On the same principle they see at some distance distinctly through a pinhole in a card; and when they try to view distant objects, they half close their eyelids as above mentioned.

They see objects beyond the limits of their distinct vision multiplied.

Myopic persons prefer small print or writing to read, and short lines. Long lines, in consequence of the great degree of convergence of the two eyes in reading, cannot be surveyed at a glance, as they can be by a far-sighted person, who, holding the book further off, does not require to converge his eyes so much.

A great inconvenience attending the higher degrees of myopia is the necessity the persons are under of stooping over their work.

Appearances presented by the eyes of near-sighted, or myopic, persons. 1st. *External appearances.*—In many cases there is nothing peculiar to be observed. Generally, however, the eyes are prominent and firm to the touch. The cornea is very convex looking, but this is rather owing to the depth of the anterior chamber than to an actually greater convexity than natural, as has been shown by the measurements of Professor Donders.

The more backward position of the lens, as indicated by the greater depth of the aqueous chamber, would of itself be a condition for far rather than near-sightedness, if it was not that that condition is, as above mentioned, more than compensated by the distance of the retina behind being proportionally so much greater than normal.

Of course, cases of prominent cornea from corneitis and of conical cornea are here excluded.

The pupil is usually large in short-sighted persons, except in advanced life.

2nd.—*Internal appearance.*—*Ophthalmoscopic examination of the myopic eye.*—It has been above said that the preternatural elongation of the antero-posterior axis of the eyeball, occasioning too great a distance of the retina behind the crystalline lens, to which myopia is most commonly owing, is the result of posterior sclerotic staphyloma.

The ophthalmoscopic appearances, therefore, which we expect to meet in a case of myopia are identical with those above described under the head of posterior sclerotic staphyloma (p. 298).

Accordingly we find on examination, except in moderate degrees of myopia in young persons, the white crescentic shaped patch on the temporal side of the papilla optica, characteristic of posterior sclerotic staphyloma.

The crescentic shaped patch of exposed sclerotica by its concavity adjoins the papilla optica. The form of the latter may be at the same time altered from a circular to an oval shape by the implication of the entrance of the optic nerve in the staphylomatous bulging of the sclerotica, as already explained under the head of posterior sclerotic staphyloma.

In such a case, the oval papilla and the adjacent semilunar patch of sclerotica together present, at first sight, very much the ordinary appearance of the papilla, thus:—

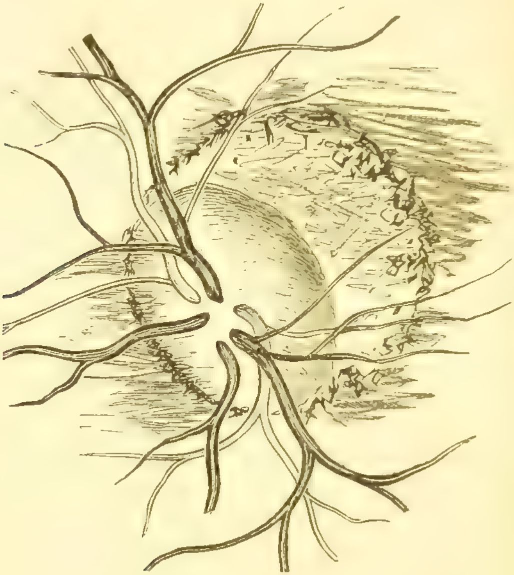

FIG. 129. Inverted image, right eye.

Diagnosis.—A person who is very hypermetropic cannot well graduate his power of adjustment by a moderate convergence of the visual lines. When he attempts to look at anything near, excessive convergence takes place, and, along with this, adjustment for such a great degree of nearness that he holds the book in reading as close to his eye as if he were extremely myopic.

To see to read at a convenient distance, the hypermetropic person can thus not call into action a suitable degree of his power of near adjustment, but requires the help of strongly convex glasses. A myopic person, on the contrary, can call into action his adjusting power in any degree within the limits of its range. Converging for his medium point, he can relax all adjusting action. Whilst in directing his eyes to less near objects, he can call into action his power of far adjustment.

When the near-sightedness is very great, the necessary degree of convergence of the two eyes on the book for binocular vision cannot be maintained without fatigue. The person, therefore, gets into the habit of reading with one eye. In extreme cases strabismus divergens is liable to supervene.

The difficulty of maintaining the necessary degree of convergence for binocular vision is owing to the oval form of the eyeball not admitting of the usual free motion, and to the altered direction of the visual lines.

Whilst thus, as pointed out by Dr. Donders, myopia leads to muscular asthenopia, *i. e.*, asthenopia from fatigue of the internal recti, which passively yields to strabismus divergens; hypermetropia causes asthenopia from fatigue of the near adjusting apparatus, which asthenopia is actively overcome by strabismus convergens.

Attention has been above (p. 69) directed to the distinction of true or optical short-sightedness under consideration from that short-sightedness which depends on defective sensibility of the retina. In this latter form, which may be named amblyopic short-sightedness, although objects are seen better near at hand, they are not seen distinctly, as in true short-sightedness; and help is obtained from convex instead of concave glasses.

In amblyopic short-sightedness, near objects are, as above said, seen better. This is because they are seen larger. On the same principle, convex glasses help the sight. Well illuminated objects are seen better, on account of the stronger impression made on the retina.

An analogous form of short-sightedness is occasioned by impaired transparency of the lens (pp. 69 and 412).

Subjects of short-sightedness.—This defect of vision seldom occurs in so great a degree before puberty as to be troublesome; when in a great degree in children it may be a symptom of central cataract (p. 351). After puberty, when the eyes come to be used in earnest, short-sightedness is usually first discovered to exist, and it may go on gradually increasing, especially if the person uses his eyes much in reading, and on minute objects. This involves strong convergence of the eyes, and a stooping position, which tend very much to promote determination of blood to the eyes, and so aggravate the posterior sclerotic staphyloma, on which the near-sightedness depends. Hence the greater frequency of short-sightedness among the educated classes, and those whose occupation is with minute work. Myopy does not diminish with years. We meet with persons of the most advanced age who still find it necessary to use glasses as deeply concave as they did in youth, if not more so.

Middle-aged persons whose vision was supposed to be previously good for ordinary distances, at the same time that they lose the power of adjustment for near objects often find that they cannot see so far off as before. This I consider to be owing to the loss of a power of adjustment for distant objects.

Predisposition to myopia is congenital, and nearly always hereditary.

As the highest degree of myopia depends on much developed posterior sclerotic staphyloma, and as the development of this is progressive, the highest degrees of myopia occur in advanced life.

Prognosis.—A real diminution of near-sightedness seldom or never takes place. Any apparent diminution which may occur arises from flattening of the lens, with diminution of its refractive power.

The tendency of myopia is to increase. In other words, when posterior sclerotic staphyloma has once begun, it is prone to go on increasing.

In the higher degrees of posterior sclerotic staphyloma, with myopia, there is often congestion, both internal and external, of the eyes, with amblyopia. In such a case the eyes are irritable and easily fatigued.

The eyeballs are hard to the touch, and the patient complains of a feeling of tension, perhaps pain on pressure, and that he sees motes floating before his sight, as well as occasional sparks of light.

The muscæ seen are, perhaps, not merely of the ordinary kind, but appearances produced by large shreds and floccules, which the surgeon may observe with the ophthalmoscope, floating in the vitreous humour which has become morbidly fluid.

In a still more advanced stage of the disease at the bottom of the eye, the sight is more involved. The case may end in blindness, from detachment of the retina by effusion between it and the choroid, from extravasation of blood in the region of the yellow spot, or atrophy and degeneration of the optic papilla and retina.

From what we have seen of the condition of the eye causing near-sightedness, it is clear that the eye must not only remain near-sighted, but is liable to become more so. A cure of short-sightedness is, therefore, out of the question.

Treatment.—To persons whose occupation is with minute objects, short-sightedness, unless in a very great degree, is rather an advantage, as they are enabled to observe all the details of their work very accurately; and in the ordinary exercise of vision, the use of concave glasses is a ready and simple help.

When a tendency to short-sightedness manifests itself in young persons, much exertion of the eyes on minute work should be avoided, and the eyes frequently exercised on large and distant objects—objects not nearer than fourteen or sixteen inches.

Concave glasses help the vision of short-sighted persons for distant objects, simply by increasing the divergence of the rays of light before they enter the eye, so that, supposing the refractive power of the media of the eye not increased, but the distance of the retina behind the lens increased, they may be brought to foci at a greater distance behind the lens than they would otherwise have been, in order to correspond with the greater distance of the retina behind the lens.

By the use of concave glasses the necessity of holding the object near the eyes, or stooping over it, and thereby strongly converging their axes on it, is superseded.

An eye which can see distant objects distinctly, that is, can bring parallel rays to foci on the retina, and which can see objects distinctly at any ordinary distance up to six or eight inches, that is, can bring more or less divergent rays to foci on the retina, may, we have seen, be viewed as a model eye. It is the eye named by Dr. Donders *emmetropic.*

An eye under the influence of atropia, that is, having its adjusting muscular apparatus for distant objects excited to full action, which can see near, but which still cannot see objects at any considerable distance distinctly, that is, cannot bring parallel rays to a focus on the retina, is myopic.

If the person be supplied with concave glasses, enabling him to see distant objects, that is, glasses fitted to render parallel rays somewhat divergent before entering the eyes, his sight is practically rendered emmetropic, if the adjusting power of his eyes is good.

When the action of the atropia subsides, the adjusting muscular apparatus for distant objects relaxes, and the person, with his spectacles on, can, like the person with emmetropic eyes, see objects at medium distances, and, by the exercise of the adjusting muscular apparatus for near objects, can see distinctly near and minute objects at any ordinary distance up to six or eight inches.

In cases of myopia with good adjusting power, concave glasses are to be selected of such focal length as will enable the person to see distinctly objects at a distance—say twenty feet—without any straining. By the action of the near adjusting apparatus, he will, with these glasses, be able to read, and by the action of the far adjusting apparatus he will be able to see distant objects.

In cases of myopia in which the medium distance at which objects can be seen distinctly is, let us say, twelve inches, when the adjusting power is lost with the advance of life, convex glasses are required to render the vision distinct at nearer distances than twelve inches, and concave glasses to render the vision distinct at further distances.

In high degrees of myopia, owing to a much developed posterior sclerotic staphyloma, the retina has suffered so much that to the near-sightedness there is superadded amblyopia. In such a case the sight is not much improved by concave glasses, because what may be gained by improved definition is lost by diminution in size of the images on the retina. In such a case, Dr. Donders thinks it is better to use one eye only at a time, and that without a glass, so as to avoid the irritation which arises from the attempt to converge the two eyes on the object. The patient generally finds this out himself.

Concave glasses are made of different degrees of concavity, the shallower being those adapted for the slighter degrees of short-sightedness, the more concave for the greater degrees.

When very short-sighted, a person requires to use concave glasses, not only to be enabled to see distant objects, but also for reading with, in order to avoid the necessity of stooping. For the latter purpose shallower glasses suffice. Less short-sighted people use glasses only to be enabled to see distant objects.

Young near-sighted persons with good adjusting power may, however, use spectacles with one power of concaves for all distances. The glasses being deep enough to diverge slightly divergent or even parallel rays so much, that on their entrance into the eye when in a state of far adjustment, they may be divergent enough to be by the refractive media brought to foci on the abnormally deep-seated retina. The near-adjusting apparatus being called into action when near objects are looked at, the refractive power of the eyes is so increased that the rays from the near object which are divergent, and which are rendered still more so by the deep concave glasses, are brought to foci on the retina.

The power of lens to be selected is that which will neutralise the myopic conformation of the eyes, and thus enable the person to see distant objects distinctly.

With the advance of life, however, say about the age of forty-five, when the adjustment for near objects becomes impaired, shallower concaves will suffice for reading with, and even for looking at distant objects. At this time of life the refractive power of the lens becomes diminished, and in consequence of the less size of the pupil, the circumferential rays are excluded. Shallower concaves thus answer sufficiently well.

The effect of concave glasses is to change the relative range of accommodation in respect to convergence of the eyeballs, to the position proper in emmetropia, and thus to impart to the eyes an optical power equal to that in emmetropia, so that they may, by the exercise of their adjusting apparatus, be capable of distinct vision when converged on objects at the different distances at which emmetropic eyes would be able to see them distinctly.

Too strong convergence of the eyes and a stooping posture are thus guarded against.

When the adjusting power of the eyes is impaired or has not been exerted from youth, by wearing neutralizing concaves, it will be necessary to use glasses of less concavity to read with, than are necessary for viewing distant objects.

The negative focal length of the concave glass which a person will require to see objects at a distance, should be about equal to the distance at which he can see to read distinctly an ordinary type with the naked eye—six inches, for example.

Such glasses impart to the parallel rays from the distant objects a divergence equal to that which rays from objects at the distance of six inches would have.

and so the eyes are enabled to bring them to foci on the retina.

To determine whether such glasses will suit for the ordinary exercise of vision, the myopic person should be directed to look with them at Snellen's letters No. XX. (p. 69), placed at the distance of twenty feet, and see how he is able to read. Glasses the next degree shallower are then to be tried instead, and afterwards glasses of the next degree deeper. The person will thus be enabled to judge whether the pair of glasses fixed on by the calculation be practically of too strong or too weak power, or quite suitable.

In wearing spectacles, the glasses are necessarily at a certain distance from the eyes. If the person finds he sees better by bringing them closer to the eyes, then the glasses are not sufficiently concave. If, on the contrary, the person finds he sees better by removing them a little further from the eyes, the glasses are too concave. The reverse holds with respect to convex glasses.

The focal length of the concave glass which a very short-sighted person will require to read with at a convenient distance, is determined thus:—Suppose he sees to read with the naked eye at the distance of six inches, and desires to be able to read at the distance of twelve, the one distance is to be multiplied by the other, and the product seventy-two divided by the difference between the two distances, viz., six. The quotient, twelve, is the number of inches, the focal length of the glass required should be.

But when a person finds it necessary to have recourse to glasses for shortsightedness, he should go to an optician, and select two or three pairs which appear to assist his vision best; or send for two or three pairs of about the focal length which, according to the above calculation, he thinks will suit him, and try them leisurely at home for a day or two before fixing his choice on one particular pair.

The following are the circumstances which should guide him in his choice:—

The glasses should be of a power which will enable him to distinguish objects as he wishes, quite readily and clearly, and at the same time comfortably. If they should make objects appear small and very bright, and if in using them the person feel his eyes strained and fatigued, or if he becomes dizzy, and if after putting them aside the vision is obscure, they are not fit for his purpose—they are too concave.

Having once fitted himself, a person should not too hastily change his glasses, although they may appear not to enable him to see quite so clearly as when he first used them.

In high degrees of myopia the improved definition from deep concaves is counterbalanced by the diminished size of the image; the person, therefore, prefers shallower concaves for use than the high degree of myopia would indicate. In very high degrees of myopia, being no longer able to converge the two eyes without straining, he prefers using one eye only, and that often without the help of any glass at all.

Except in such extreme cases, a glass to each eye should always be employed; vision is by this clearer, and its exercise less fatiguing to the eyes, than when a glass to one eye only is used. The use of a glass to one eye only is, in fact, very detrimental, especially to the opposite eye.

A person who has not from youth used concaves deep enough to neutralise the myopic conformation of his eyes, or not used concaves at all, has necessarily not had occasion to exercise his near-adjusting power much. That power, having thus lain long in abeyance, cannot be afterwards brought fully into use. The person, therefore, cannot take to neutralising concaves. He must use glasses no deeper than is sufficient to enable him to see at the particular distances required—for reading or writing with—for reading music—or for distant vision.

Therapeutic treatment in myopia.—If symptoms of internal congestion, with irritation, present themselves (in internal congestion, capillary hyperhæmia of the papilla and retina is observed under the ophthalmoscope), and if fatigue and pain in the eyes come on by using them, especially by candle-light, all work must be suspended, and stooping avoided. The closed eyes are to be douched with cold water, and attention directed to the liver and bowels.

A boy was brought to me who, it was stated, had suddenly become affected with near-sightedness. I dropped the four-grain solution of the sulphate of atropia into the eyes, and after its influence had passed away, the short-sightedness was no longer complained of.

This appears to have been a case of spasm of the near-adjusting muscular fibres, counteracted by the contraction of the far-adjusting muscular fibres excited by the atropia.

7th.—*Hypermetropia, or over-sightedness.*

Hypermetropia is the reverse of myopia. Whilst in the myopic eye the retina is so far behind the crystalline that even in the lowest state of refraction to which the eye can be brought by the exertion of its far-adjusting apparatus, parallel rays, or even moderately divergent rays, are brought to foci before reaching it, so that objects at any considerable distance cannot be distinctly seen;—in the hypermetropic eye, on the contrary, the retina is so close behind the crystalline, that in the state of refraction corresponding to the relaxation of all adjustment, and still more in the lowest state of refraction to which the eye can be brought by the exertion of its far-adjusting apparatus, even parallel rays are made to converge so little that they tend to come to foci only behind the retina, so that objects cannot be seen distinctly at any distance—far or near. (Fig. 128, p. 468.)

Appearances presented by hypermetropic eyes.—The conformation of an eye affected with hypermetropia is peculiar. It is small and sunk-looking, and immediately round the cornea the sclerotica is flat, indicating that the antero-posterior diameter of the globe is shorter than natural. A section in the direction of that diameter would thus have an elliptical outline—the short axis of the ellipse corresponding to the antero-posterior diameter.

The cornea of a hypermetropic eye is often small and dull-looking, and appears flatter than natural, in consequence of the lens and iris being inclined towards it, so that the anterior chamber is diminished in depth. The effect of this more advanced position of the lens should be to increase the refractive power of the eye; but such an effect is, in hypermetropia, more than counterbalanced by the shortness of the antero-posterior axis.

The pupil is small.

When the person looks at distant objects there is perhaps apparent divergent strabismus, whereas when he looks at near objects, convergent strabismus is liable to occur.

Hypermetropia is often hereditary.

Peculiarities of the vision of hypermetropic eyes.—Without the exertion of the near adjustment, hypermetropic eyes thus cannot bring parallel rays, much less divergent rays, to a focus on the retina, so that they cannot see distinctly either distant or near objects. To see without an effort of near adjustment, convex glasses are required, in order to render the rays, at their very entrance into the eye, convergent, so that the refractive power of the latter may be enabled to bring them to foci at a short enough distance behind the crystalline to impinge on the retina.

In hypermetropia, the power of adjusting the eye exists, and fails only, as usual, with the advance of life.

When with their visual axes parallel the eyes can, by a moderate exercise of their near-adjusting power, see distant objects distinctly, that is, can bring parallel rays to foci on the retina, Dr. Donders names the hypermetropia *facultative.*

In respect to the exercise of the adjustment for near objects, it is to be observed:—that in order to bring divergent rays to foci on the retina, it has to increase the refractive power of the eye from a state in which even parallel rays cannot be brought to foci on the retina. This implies an abnormally great exertion on the part of the near-adjusting apparatus, and one which is not in relation with the convergence of the visual lines of the two eyes. Indeed, in order that such an effort may be made, the eyes must be at the same time very much converged as above mentioned. Hypermetropia in this degree Dr. Donders designates *relative.*

In extreme cases, the eyes are incapable of an intermediate moderate degree of convergence and adjustment, so as to see at the distance, say of eight or ten inches. When the patient tries to read, the adjustment is by a spasmodic effort made for so short a distance, that he holds the book close to the eye, and thus appears to be very near-sighted; whilst in consequence of the accompanying great convergence of the visual lines the two eyes cannot be simultaneously fixed on the object looked at. One eye only is therefore used, and convergent squint of the other, perhaps, takes place.

Hypermetropia in young persons may thus, as above pointed out, be mistaken for myopia combined with some degree of amblyopia. The apparent near-sightedness in hypermetropia is accompanied by a desire for more light, which is not the case in true myopia, unless accompanied by amblyopia.

Convex glasses, by rendering the spasmodic effort at near adjustment unnecessary, enables the person to see at a proper distance; so that we have the apparent anomaly of a very short-sighted person being enabled to see further off with convex glasses.

By the use of suitable convex glasses (glasses strong enough to neutralize the hypermetropic condition of the eyes are required), a displacement of the relative range of adjustment is effected, so that the necessary harmony between convergence of the eyes and their near-adjusting power is established. The person is thus enabled, by the exercise of the adjusting power, now to read without undue convergence, now to see distant objects with parallel visual lines.

By the fact that distant objects are seen more distinctly with convex glasses, the existence of hypermetropia is declared.

It is here to be remarked, that an originally hypermetropic eye may have the far-adjusting apparatus as well as the near; but the effect of the action of the former is, on account of the conformation of the eye, worse than no adjustment. Unfocalizing the eye still more, it is not usually called into play; but by atropia, the far-adjusting apparatus may be excited to action, and what Dr. Donders calls *latent* hypermetropia is made manifest.

In early life, with good adjustment, hypermetropia in a moderate degree may not be much complained of, but as with the advance of life the adjusting power becomes impaired, prolonged exertion of the sight in reading, sewing, or other fine work, comes to be difficult or impossible. Asthenopia has then set in.

Persons requiring convex glasses at about thirty-five or forty years of age, or even younger, will probably be found hypermetropic.

With the advance of life the adjusting power of the eye for near objects, even with the strongest convergence of the eyes, fails, and the person ceases to be able to read without convex glasses adapted for the particular distance at which he wishes to see to read.

To see distant objects, convex glasses of a lower power are required.

In this case, Dr. Donders calls the hypermetropia *absolute.* It might be also called presbyopia in the hypermetropic eye.

Choice of glasses for hypermetropic eyes.—Try the eyes with convex glasses until the strongest are found with which the person sees distant objects distinctly, *i.e.*, the strongest convex glasses required to render parallel rays, or the rays from distant objects, convergent enough on entering the eye to admit of being brought by the refractive power of the eye to foci on the retina, which is spread out at so short a distance behind.

Practically, it will be sufficient to try with what power of convex glass the patient can see to read Snellen's letters No. XX. (p. 69), at the distance of some twenty feet. Usually this will be found to be forty-eight or thirty-six inches focal length.

It may happen, however, that in this trial the near-adjusting power of the eye is still unconsciously called into play, so that the full degree of hypermetropia is not manifest. To render evident the full degree of hypermetropia, the far-adjusting apparatus must be called into action by the application of atropia.

As atropia excites the far-adjustment of the eye, the convex glasses which enable the eye under the influence of atropia to see distant objects—that is, convex glasses of such a power as combined with that of the refractive media will bring parallel rays to foci on the retina, and thus render the eye practically emmetropic—are the power to be chosen.

With such convex glasses the patient, if the adjusting power of his eye be good, will see surrounding near objects distinctly when, by the cessation of the action of the atropia, relaxation of the far-adjustment takes place, and will see to read by an exertion of the near adjustment. For this purpose, however, it is usually found that glasses of greater convexity are required. Glasses, namely, of such a power as will enable the person to see quite distinctly at the distance of twelve or sixteen inches, without exertion of their near-adjustment, and at a nearer distance by exertion of the near-adjustment.

The required power may be ten or even six inches.

Convex glasses of low power appear to help well in hypermetropia for reading or sewing, but this is because, with the convergence of the eyes, the near-adjustment to a great degree comes into play,—to a greater degree than is desirable. Substitute stronger convex glasses, and this habit of over-exerting the near-adjusting apparatus will be rendered unnecessary.

Myopic persons, it has been above shown, are naturally not necessitated to exert their near-adjusting power much. Hence, if they do not in youth begin to wear concave glasses deep enough to neutralize the myopic conformation of their eyes, and thus necessitate themselves to exert their near-adjusting power in reading, &c., they find it difficult to do so later in life. They can only use the deeper concaves for distant objects, and shallower for near objects.

Hypermetropic persons, on the contrary, are naturally necessitated to exert their near-adjusting power to the utmost. Hence, if they do not in youth begin to wear convex glasses sufficient to correct the hypermetropic conformation of their eyes, and thus necessitate themselves to exert their near-adjusting power less—if not, even, to exert their far-adjusting power, they find it difficult to use, for distant objects, convex glasses of a power strong enough for reading or sewing.

They are disposed to select glasses to see distant objects with, of a lower power than will subsequently be desirable. This is because the habit of exerting their near-adjusting power to the utmost is unconsciously still persisted in while the glasses are being tried. After using for some time the glasses selected, however, the patients become able to relax the near-adjusting power when trying other glasses. They then find that with stronger convexes than those they had at first chosen, they can exercise sight with less straining and more comfortably.

8th.—*Presbyopia, or old-sightedness.*

With the advance of life, the power of the eye to adjust itself for vision at different distances becomes impaired, and after middle-age it is usually altogether lost. After middle-age, indeed, failure of the adjusting power of the eyes is so common that it is to be viewed as a natural change in the state of the eye.

The defect of sight arising from failure of the adjusting power of the eye is named presbyopia (from πρεσβυς, old, and ὀψ, the eye).

In presbyopia, the person can see only at the distance which the anatomico-optical conformation of his eyes allows. The previously emmetropic eye can see only at a distance,—the myopic eye still requires concave glasses for seeing distant objects, but may require convex glasses to see very near objects distinctly,—whilst the hypermetropic eye becomes incapable of seeing at any distance without convex glasses sufficient to neutralise the hypermetropia in viewing distant objects, and still stronger convex glasses to compensate for the failure of the adjusting power in viewing near objects.

As failure of the adjusting power of the eye is not so much felt in myopia as in emmetropia, our ideas of presbyopia have been founded on it chiefly as it manifests itself in the latter, and therefore it has come to be synonymous with far-sightedness.

In treating of presbyopia, however, it will be necessary to consider it successively under the heads of presbyopia in the emmetropic eye,—in the myopic eye,—and in the hypermetropic eye.

9th.—*Presbyopia in the emmetropic eye.*

With this state of vision the person can see objects distinctly only when they are at a very considerable distance from the eyes; in reading, for example, he holds the book at arm's length.

The power of adjusting the eye for different distances being much impaired, the rays of light from nearer objects, as they are more divergent, tend to come to a focus at a point behind the retina, on which therefore they impinge in circles of dissipation, and form indistinct and confused images.

By removing the object from the eyes, it comes to be distinctly seen, because the rays from it which enter the eye, being now less divergent than when it was near, are more quickly brought to a focus; in other words, the different points of the object as foci of incident rays, and the foci to which these rays are brought in the interior of the eye by the refractive media, are *conjugate foci;* and accordingly, when the foci of incident rays are removed from the refractive media, the foci of refracted rays come near them.

In trying to read, the attempt to exert the power of adjustment induces fatigue and confusion of vision, though in such a case it will probably be found that the eye is affected with hypermetropia in a slight degree.

In commencing presbyopia, the near-adjusting power is not lost,—it is only impaired in respect to range, so that the person can no longer adjust for a nearer distance perhaps than twenty inches.

As the adjusting power becomes more impaired, stronger convexes are required. When it is quite lost, convex glasses of different powers are required to correspond with the different distances of the objects looked at.

Appearances presented by emmetropic eyes affected with presbyopia.—In many cases there is nothing peculiar to be observed; but frequently the crystalline and iris are inclined towards the cornea, which in consequence of the resulting diminution of the depth of the anterior chamber appears flat. The pupil is small.

Peculiarities of presbyopic vision in persons originally emmetropic:—

1. They see small objects indistinctly at every distance, because when near, they are out of focus, and when removed from the eye somewhat, they are seen at a small visual angle and with little light. By increasing the light, contraction of the pupil is excited, and they see better. Hence, they do not see so well by candle-light as before, and when attempting to read by candle-light, they place perhaps the candle between them and the book held at arm's length.

2. They see large and distant objects very distinctly.

There is no complaint of fatigue. The complaint merely is that the sight is indistinct, except for distant objects, and that lines and points appear multiplied, whether both eyes or one only is used.

The presbyopic-emmetropic eye cannot by any effort see near at hand. It can see only at some distance. With a suitable convex glass it can see near objects.

The hypermetropic-asthenopic eye, on the contrary, can by an effort of adjustment see near at hand, but only for a short time. Fatigue of the adjusting power quickly supervenes, and confusion of sight takes place.

Prevention and treatment.—Although presbyopia depends on a change in the state of the eye which takes place naturally with the advance of life, something may be done in the way of retarding its progress, and thus so far preserving the sight, by avoiding over-exertion of the eyes in reading and other minute work, especially by artificial light, at the time of life when diminution of adjusting power usually comes on.

Convex glasses help the vision of presbyopic people who have been originally emmetropic for near objects, by diminishing the divergence of the rays of light before they enter the eye, so that they may be more speedily brought to foci than they would otherwise be, in consequence of the diminished power of the near-adjusting apparatus of the eye.

Presbyopic persons, at the same time that they have lost the power of adjustment for near objects, may be somewhat cataractous, or have their retina impaired in sensibility. In such cases, convex glasses, besides remedying the defective adjustment, are of use by their magnifying power; somewhat stronger glasses are therefore to be ordered.

Convex glasses are made of different degrees of convexity. The least convex being those adapted for the slighter degrees of far-sightedness, the more convex for the greater degrees.

To see distant objects, emmetropic persons, who have become presbyopic, do not in general require convex glasses. It is most commonly to enable them to read and do minute work that they use spectacles.

If it is only at a *very great* distance that a person can see distinctly, the focal length of the convex glass which he will require to enable him to read will be equal to the distance at which he wishes to see to read. If he wishes to see to read with the book ten inches off, he will require convex glasses of ten inches focal length.

If he is not so very far-sighted, but can see small objects distinctly at twenty inches distance, for example, the focal length of the convex glasses which he will require to enable him to read at twelve inches distance, is determined by multiplying the two distances together, and dividing the product, 240, by the difference between them, viz., eight. The quotient, thirty, is the focal length in inches of the glasses required.

But when a person finds it necessary to have recourse to glasses for far-sightedness, he should go to an optician, and select two or three pairs which appear to assist his vision best, or send for two or three of about the focal length which, according to the above calculation, he thinks will suit him, and try them leisurely at home for a day or two before fixing his choice on one particular pair.

The following are the circumstances which should guide him in his choice:—The glasses should be of sufficient power to enable him to see objects distinctly as he wishes, and at the same time comfortably. With glasses of too ow a power fatigue and confusion of sight supervene. Glasses which make the objects appear larger than natural, and strain and fatigue the eyes and cause headache, are not adapted to his case,—they are too convex. It is usually found that glasses the next degree more convex are required for work by artificial light.

The alteration in the eye on which the far-sightedness depends, generally goes on to increase with age, hence it is necessary after a time—a few years—to change the glasses first chosen for others more convex. In regard to this exchange it is to be observed, that it ought not to be too hastily had recourse to, nor, on the other hand, too long delayed. The same feeling of necessity which first prompted to the use of glasses, will indicate the necessity of change.

In changing, the glasses previously in use for the evening are to be adopted for the day, and a pair one degree stronger procured for evening work.

When the patient manifests a disposition to try a frequent change of his spectacles, a glaucomatous state of the eye will probably be discovered on examination.

In advanced age, to total failure of the adjusting power, is superadded a hypermetropic state from diminished refractive power of the media of the eye, so that even parallel rays cannot be brought to foci on the retina. To see distant objects, therefore, convex glasses are required, though of a power lower than those necessary for reading with.

Reading glass.—This is a double-convex lens, used for the purpose of magnifying the object,—the names on maps, or the like; whereas, convex spectacles are used merely to render objects distinct at a given distance, without magnifying them, as above mentioned.

10th.—*Presbyopia in the myopic eye.*

With loss of power of adjustment, the myopic eye ceases to see well so near or so far off as formerly. It sees perfectly distinctly, perhaps, at one particular distance only. And that distance depends on the anatomico-optical conformation of the eyeball.

Suppose the distance be twelve or fourteen inches, the person will require convex glasses to see nearer objects perfectly distinctly, and concave glasses to see more distant objects.

Suppose the distance at which the person can see perfectly distinctly be about ten inches, he will be able to read, write, and do any other near work without the assistance of convex glasses to make up for the loss of his near-adjusting power.

To see distant objects, he will still require concave glasses.

Myopic eyes affected with presbyopia, though they do not possess any intrinsic power of adjustment whereby they can bring to foci rays diverging from a nearer or further distance than the one particular distance above referred to, can still see the different objects in a room distinctly enough without the aid of glasses, and in the street or open country can see objects distinctly enough for all practical purposes with the aid of concave glasses.

Directing his eyes to an object two or three feet from him, the person will see it distinctly enough, whilst an object in the same field of view at the distance of ten or twelve feet is at the moment seen very indistinctly.

If now he directs his eye to the object at the distance of ten or twelve feet, he sees it distinctly enough, but the object at the distance of two or three feet now appears very indistinct.

This might be considered an evidence of adjustment of the eye for the two different distances. There is, however, no real intrinsic adjustment in the case. Either the nearer or the more distant object is seen distinctly enough, merely because by directing the eye to it, its image falls on the central and most sensitive part of the retina, whilst the image of the other object falls on the circumferential and least sensitive part of the retina.

It is to be observed that at neither the nearer nor the further distance is the object seen exactly defined on directing the eye to it. On directing the eye to the further object, it is of course seen less defined than the nearer object when the eye is directed to it; but the difference is not at a glance very striking.

11th.—*Presbyopia in the hypermetropic eye.*

With loss of power of adjustment, the hypermetropic eye ceases to see distinctly at any distance. The distance of the retina behind the crystalline body being so short, even parallel rays of light tend to come to a focus only at a point behind that nervous membrane, on which, therefore, they impinge in circles of dissipation, and form indistinct and confused images.

To see distant objects, convex glasses of a power sufficient to neutralise the hypermetropic conformation of the particular eye are required; that is, convex glasses which will converge parallel rays so much at their entrance into the eye, that they will admit of being brought by the refractive media to foci on the retina.

The hypermetropia being neutralized, the presbyopia or defect of adjustment still remains, so that glasses for different distances are necessary.

To see nearer objects, proportionally more convex glasses are required, the power being adapted to each particular distance at which it is desired to see distinctly.

As hypermetropia from diminished refractive power of the eye takes place from senile changes in the emmetropic eye, so also in the originally hypermetropic eye the hypermetropia increases in the same manner.

12th.—*Paralysis of adjustment.*

The failure of the power of adjustment in presbyopia appears to be owing, not to paralysis of the muscular fibres subservient to that act, but to a change in the condition of the lens, whereby it no longer admits of the necessary alteration of form.

It has been above mentioned that in the lenses of the eyes of old people the circumference is marked with radiating indentations. These I consider impressions which have been made by the fibres of the orbiculus capsulo-ciliaris in the course of the frequent acts of adjustment, and which have become permanent in consequence of the loss of elasticity of the lens. The result is, that the anterior surface of that body no longer admits of being rendered more convex, though the muscular fibres subservient to the act of near adjustment, may continue as capable of action as their associates, the circular muscular fibres of the iris, evidently are. Again, in consequence of its firmness and loss of elasticity, the lens, in advanced age, though it tends slowly to become permanently flatter, cannot, for an occasion, undergo a transient flattening. The muscular fibres originally subservient to the adjustment for the lowest state of refraction, therefore, cannot now produce any impression on it, though they may still continue as capable of action as the radiating fibres of the iris with which they are associated, and equally with which they are susceptible of the influence of atropia, and under the control of the sympathetic.

True paralysis of adjustment presents itself in two forms, viz., 1st, paralysis of adjustment for near sight; and, 2nd, paralysis of adjustment for distant sight.

Paralysis of adjustment for near sight.—This is identical with mydriasis above noticed (p. 454). At the same time that the circular muscular fibres of the iris are paralysed, so that the pupil cannot be contracted, the muscular fibres subservient to the near adjustment of the eye are paralysed, so that near objects cannot be distinctly seen. If the patient's eyes be naturally myopic, he may be still able to read or write; if emmetropic, he is unable to do so except with convex glasses, but is able to see at a distance as before; if hypermetropic, he is more incommoded, as he can see neither near nor distant objects distinctly without convex glasses.

Treatment.—See *suprà*, Mydriasis, and *infrà*, Paralysis of oculo-motor nerve.

As allied to paralysis, cases of defective sight occurring after debilitating disease, and described under the name of *paresis*, or debility of adjustment, fall to be noticed here. There may or may not be accompanying mydriasis. The symptom is inability to see at so near a distance as usual. In this respect the case resembles one of presbyopia, but differs in respect to the circumstances under which it comes on. As the inability to see to read is manifest at the first attempt, the case cannot be confounded with asthenopia.

The defect of vision which has been found to occur in persons recovering from *diphtheria faucium*—often along with debility of the muscles of speech and deglutition, and paralytic symptoms of other parts—Dr. Donders has recognised to be owing to a *paresis* of the muscular fibres subservient to the adjustment of the eye for near sight.

This paresis of the adjusting apparatus is of course most felt by hypermetropic and emmetropic eyes, much less by myopic eyes.

Treatment.—Though convex glasses help the sight for near objects, they are not to be had recourse to. With the restoration to health the eyes regain their adjusting power, and near objects are seen distinctly as before.

Towards such a consummation good diet and tonics ar the auxiliaries obviously indicated.

Paralysis of adjustment for distant sight.—We have a example of this in those cases of myosis above referred to as the effect of pressure on the sympathetic in the neck by tumours, &c. (p. 451).

13th.—*Asthenopy, or weak-sightedness.**

Subjective symptoms.—An inability to exercise vision on near objects, as in reading, sewing, and the like, for any length of time. The patient is able at first to see to read distinctly enough, but the vision soon grows confused,—the words appearing as if mixed together. The eyes at the same time become tired and painful—the pain extending to the head.

If the eyes are closed, and rest given to them for a few minutes, vision may be again exercised, but in a short time the eyes will become fatigued, and the vision confused as before. Both eyes are in general equally affected.

The vision of distant objects is not complained of though in extreme cases distant objects also, on being fixed, fade from the sight. By the use of convex glasses the exercise of vision on near objects is much assisted.

Objective symptoms.—There is in general no positive appearance of disease. The eyeballs, however, may be sunk looking, the cornea of small diameter, its aspec dull, from a want of smoothness of surface, as may b seen by the irregularity of reflection of the light when under examination with a magnifying glass; the pupil sluggish, though sometimes quite active, the iris ofte pale, and bleached looking.

The eyes are directed towards objects in a weak, indecisive manner. They have a divergent direction, but in converging them strongly, in the effort to adjust for nea objects, convergent squint is apt to take place.

Nature of the complaint.—Asthenopy has its origin i the hypermetropic conformation of the eyeballs, which i congenital (p. 486).

The strong exertion of the near adjustment necessar to enable the hypermetropic eye to bring divergent ray to a focus on the retina, *i. e.*, to enable it to read or sew, leads to fatigue, and the subjective symptoms of asthenopy above enumerated set in.

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* Hebetudo visus.

The apparatus by which the eye is adjusted for the vision of near objects appears to be at first of natural power, but, in consequence of the over-exertion to which it is habitually subjected, it becomes incapable of being maintained in action long at a time. It is as if one were to hold a book too near. Though he might be able by an effort to adjust his eyes so as to see to read for a minute or two, the sight would then become confused and the eyes tired. The use of convex glasses would, however, prevent this.

The hypermetropic conformation of the eyeballs being congenital, asthenopy manifests itself in childhood or youth. The degree in which and the period at which it manifests itself, however, vary according to the degree of the hypermetropic conformation of the eyeball, the amount of exertion to which the sight has been subjected, and the state of the general health. Asthenopia may manifest itself before the eyes have been subjected to any great exertion. If there be, as there often is, general debility, asthenopia is the sooner and more decidedly manifested.

In moderate degrees of hypermetropia, the sight may be exerted for a long time before any complaint is made. At last, with the advance of life the range of adjustment diminishes, and the energy of the near adjusting apparatus becomes impaired and no longer able to keep up, for any length of time, the over-exertion imposed upon it.

The patients who complain of asthenopy for the first time are, many of them, students, artists, clerks, engravers, watchmakers, tailors, sempstresses, &c., who have sat up late working by artificial light and who have not had sufficient exercise in the open air.

Many also are persons who labour under general debility.

Diagnosis.—There is a form of asthenopy which is owing not to a hypermetropic conformation of the eyes and consequent trouble of the internal adjusting apparatus for the vision of near objects, but to defective power of the internal recti muscles, causing inability to maintain the eyes in the degree of convergence necessary for the vision of near objects. This weakness of the internal recti is most common in myopia, and is the cause of the asthenopic symptoms in the near-sighted. This form of asthenopy may be imitated by attempting to read with too strong convex glasses.

Another form of what may be called asthenopy depends on an irritable state of the eyes, and occurs as a sequela of inflammation, especially scrofulous ophthalmia, external and internal. In such a case uneasiness, redness and watering of the eyes, come on as soon as the patient tries to use them. There is often some degree of near-sightedness.

Hypermetropic-Asthenopy is principally to be distinguished from paralysis or paresis of near adjustment, and amblyopy, or incomplete amaurosis.

1st. *Paralysis or paresis of the near-adjusting apparatus.*—This sometimes occurs in children, and might be confounded with asthenopy, as the two have this in common, that distant objects may be seen without straining of the eyes, whilst in asthenopy during a paroxysm as well as in paresis, near objects are not. The defect in question is, however, distinguished from asthenopy in the circumstance, that by rest the eyes do not acquire the power of distinguishing near objects.

2nd. *Amblyopy, or incomplete amaurosis.*—In amblyopy there is constantly present an indistinctness of sight extending to all objects large and small, distant and near; in asthenopy indistinctness of sight comes on only after the eyes have been exerted on near objects. In amblyopy the patient sees best after having fixed his eyes for some time on the object he examines; in asthenopy, on the contrary, vision fails then.

Prognosis.—As hypermetropy depends on an original defect in the conformation of the eyes, a cure, properly speaking, is not to be anticipated, but much may be done to alleviate the symptoms. Asthenopy, though it has become confirmed, rarely passes into amblyopy, and is not likely to end in blindness.

Treatment.—The first thing in the way of treatment is the avoidance, or removal by appropriate means, of any debilitating causes, whether affecting the general system or the eyes in particular, which may appear to be in operation.

Rest to the eyes, the occasional application to them of the cold douche, good diet, exercise, country air, sea-bathing, and the like, must in general constitute a leading part of the treatment of asthenopy.

When the patient requires to employ his eyes on near objects, he has no other resource than to use convex glasses, to correct the hypermetropic condition of his eyes—see above, p. 486; but it would be advisable for the patient, if his occupation requires much use of the eyes, to change it if possible for one of an opposite kind.

Complications.—Asthenopy is often complicated with some other affection. It may be complicated with the effects of some one of the ophthalmiæ; with muscæ volitantes; sometimes oscillation of the eyes, and not unfrequently convergent strabismus, with amblyopy or incomplete amaurosis. Persons blind of one eye are not unfrequently affected with asthenopy in the other. One eye may be incompletely amaurotic, the other asthenopic. When asthenopy is complicated with amblyopy, the vision is at all times more or less obscure, but on reading, &c., it soon becomes still more so, recovering, however, after a little rest.

Asthenopy depending on defective power of the internal recti muscles.—In such cases, section of the external recti tendons has been recommended.

By the use of prismatic glasses, placed with their angle next the nose, the binocular images are thrown inwards, and instinctive exertion of the internal recti muscles is thereupon incited in order to preserve single vision.

As it is in cases of myopy that this kind of asthenopy presents itself, the glasses should at the same time possess the requisite degree of concavity. Concave glasses alone, so set in the frames that their centres are not opposite the pupil but nearer the nose are often sufficient. In this, we have a combination of a prism (with its angle next the nose) and a concave lens, p. 510.

14th.—*Distigmatism.**

In the Philosophical Transactions for 1801, Dr. Thomas Young called attention to the fact that "his eye, in a state of relaxation, collects, to a focus on the retina, those rays which diverge vertically from an object at the distance of ten inches from the cornea and the rays which diverge horizontally from an object at seven inches distance."

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* From Δὶς, double, and *στίγμα*, a point. *Astigmatism*, from *α*, privative, and *στίγμα*, a point—Cylindrical eye.

In the Transactions of the Cambridge Philosophical Society (Vol. ii., p. 267, Cambridge, 1827), Mr. Airy, the Astronomer Royal, gave an account of a similar defect of one of his own eyes which, however, contrary to what occurred in Dr. Young's case, consisted in the rays being refracted to a nearer focus in a vertical than in a horizontal plane. This would take place, he remarks, if the cornea, instead of being a surface of revolution, in which the curvature of all its sections through the axis must be equal, were of some other form, in which the curvature in a vertical plane is greater than in a horizontal. This is, in fact, the natural form of the cornea, but in the instance of Mr. Airy's eye, existing in an exaggerated degree so as to disturb vision.

From observations which I have made, I have been led to believe that astigmatism or inability of the eye to collect all the rays of light which enter it to one exact focus, is, if not the rule of sight, at least of very common occurrence. I do not, of course, refer to cases like Mr. Airy's, in which astigmatism exists in so exaggerated a degree as to be a positive defect of sight.

In a case of myopia with astigmatism, similar to that of Dr. Young, which is the rarer form, I lately made the following analysis of the sight, in respect to the astigmatism:—

If a vertical and horizontal line, both equally strong and black (Fig. 130), be viewed, they are seen with medium distinctness at the distance of about ten inches.

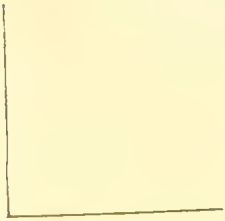

FIG. 130.

At the distance of about eight and a half inches, the vertical line is seen with greater distinctness and better definition—the greatest distinctness and best definition the eyes are capable of; but the horizontal line is seen indistinctly—with much less distinctness than that with which any part of the figure is seen at the distance of ten inches.

At the distance of twelve inches, the horizontal line is seen with the greatest distinctness and best definition the eyes are capable of; but the vertical line is seen indistinctly—with much less distinctness than that with which any part of the figure is seen at the distance of ten inches.

Or, if the person looks at his watch, held at the distance of ten inches, he sees all the figures with medium distinctness. At the distance of eight and a half inches, he sees the XII and the VI well defined, but the IX and the III ill-defined. At the distance of twelve inches on the contrary the IX and the III are seen well defined, whilst the XII and the VI are seen imperfectly so. The intermediate figures present intermediate degrees of distinctness.

It thus appears that the eyes under notice, different from the more usual case noticed at page 65, collect to a focus on the retina the rays which diverge in a horizontal plane at the distance of eight and a half inches; and the rays which diverge in a vertical plane at the distance of twelve inches.

The eyes are thus not *monostigmatic*, that is, are not capable of collecting all the rays of light which enter them to one exact focus. They are, on the contrary, *distigmatic*, that is, they have each two distinct elongated foci to which they bring the rays, viz., one focus for horizontal rays, and one for vertical rays.

The different foci in distigmatism, instead of being for rays in horizontal and vertical planes, have been met with for rays in oblique planes.

Distigmatism is corrected by the use of cylindrical lenses. If the person, whose vision is above described, wishes to see with perfect distinctness at the distance of eight and a half inches, he would make use of a glass cylindrically convex on one side of about twenty-eight inches focus, held before the eye with its axis horizontal. This glass, having the fitting degree of convexity, will bring the rays radiating in the vertical plane from a distance of twelve inches to a focus in his eye, whilst it will exert no influence on the rays radiating in the horizontal plane from a distance of eight and a half inches.

If, on the contrary, the person desired to see with perfect distinctness at the distance of twelve inches, he would employ lenses cylindrically concave on one side held before the eye with their axis vertical. This cylindrical glass, with a negative focal length of about twenty-eight inches, would so diverge the rays in the horizontal plane that they would be brought to a focus on the retina. The rays in the vertical plane being unaffected in passing through the glass would be brought to the same focus by the refractive power of the eye alone.

In a case of oblique distigmatism, the cylindrical glass would require to be held obliquely before the eye.

For use, the other side of the lens is made plane, or spherically convex or concave, to suit the condition of the eye, whether myopic or hypermetropic, irrespective of its distigmatism.

The particular power of cylindrical glass required may be determined by means of Professor Stokes's instrument above described at page 66, but the simplest plan is to have a series of cylindrical lenses both convex and concave to try until the proper one is found as above pointed out at page 65.

The following mode of calculating will help to an approximation. If a person sees vertical lines distinctly at the distance of fifteen inches, but desires to see them distinctly at the distance of ten inches—the distance, viz., at which he sees horizontal lines distinctly, the focal power of the cylindrical convex glass which he will require is determined thus:—

Multiply the two distances of fifteen and ten together, and divide the product 150 by the difference between them, viz., five. The quotient thirty is the focal length in inches of the convex cylindrical glass required.

If, on the other hand, the person desires to see horizontal lines distinctly at fifteen inches' distance, that, viz., at which he sees vertical lines, he will require a cylindrical concave lens the negative focal length of which he will ascertain by a similar calculation.

The person with myopia and distigmatism, in the case above described, is at the same time affected with loss of the adjusting power of his eyes. The following is an analysis of his case in the latter respect:—

Whilst seeing the vertical line with perfect distinctness and definition at the distance of eight and a half inches, he cannot alter the adjustment of the eye so as to see the horizontal line more distinctly and the vertical one less distinctly; and *vice versâ*, whilst seeing the horizontal line perfectly defined at the distance of twelve inches, he cannot alter the adjustment of the eye so as to see the vertical line more distinctly and the horizontal one less.

In short, he finds that he has no power of altering the adjustment of his eyes. He sees vertical lines with perfect distinctness and definition only at the distance of eight and a half inches, and horizontal lines with perfect distinctness and definition only at the distance of twelve inches, and both vertical and horizontal lines simultaneously with medium distinctness only at the distance of ten inches.

At the distance of about seven inches he sees the vertical line with medium distinctness, but the horizontal line very indistinctly.

At the distance of about fourteen inches he sees the horizontal line with medium distinctness, but the vertical line very indistinctly.

At a nearer distance than seven inches he sees both lines indistinctly, but the vertical less so than the horizontal. At a further distance than fourteen inches, on the other hand, he sees both lines indistinctly, but the horizontal less so than the vertical.

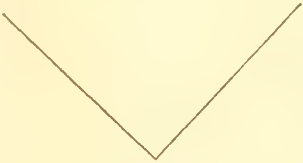

FIG. 131.

If now he views two oblique lines, both of which are equally strong and black (Fig. 131), he sees both legs with medium distinctness at the distance of ten inches.

At the distance of about eight and a half inches he sees the two oblique lines equally well, but not so distinctly as at the distance of ten inches.

At the distance of twelve inches he sees the two oblique lines with much about the same distinctness as that with which he sees them at the distance of eight and a half inches.

It thus appears that he cannot see either of the oblique lines with perfect distinctness and definition at any distance; but that he can see them both simultaneously distinctly enough at any distance from eight and a half inches to twelve inches. At a nearer distance than eight and a half inches, or a further distance than twelve inches, the distinctness diminishes, and that equally for the two lines.

He cannot by any adjustment of his eyes vary the distinctness with which he sees the oblique lines at a given distance.

15th.—*Uniocular polyopy, or manifold vision with one eye.*

When the eye is not adjusted to the distance of the object looked at—this circle (Fig. 132) for instance—polyopia with one eye occurs. Instead of appearing single and well defined, the line appears multiplied—as if made up of several overlapping lines, and ill-defined.

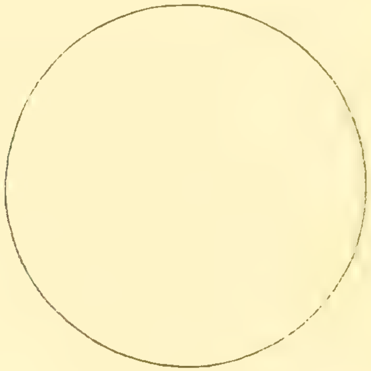

FIG. 132.

Presbyopic-emmetropic people see the line with one eye multiplied, when they try to look at it near at hand without their spectacles.

Presbyopic-myopic persons see the line with one eye multiplied when viewed at a distance either further off or nearer than that of their distinct vision.

The cause of uniocular polyopia is considered to be as follows :—

By the concentric layers of the lens, the rays of light are brought to a series of foci which all coalesce into one on the retina, when the eye is in a proper state of adjustment for the distance of the object looked at, but when it is not, the rays come to foci at various points in front of the retina, or behind it, so that a series of superposed ill-defined images of the object are projected on the retina, and the result is that the object is seen multiplied to one eye.

That uniocular polyopia depends on this cause, Dr. Donders has established by showing that when the lens has been removed there is no longer manifold vision to a single eye, however much the object may be out of focus and indistinctly seen in other respects.

The distigmatic eye, the sight of which is analysed at p. 500, if it views the circular line at the distance of twelve inches, sees the line above and below single and well defined, but the side parts multiplied and ill defined; but if it views the circular line at the distance of eight and a half inches, it sees it on either side single and well defined, whilst above and below it appears multiplied and ill defined.

If the eye views the circle further off than twelve inches, the line appears multiplied all round, but the images appear further apart at the sides.

If, on the contrary, the eye views the circle at a nearer distance than eight and a half inches, the line also appears multiplied all round, but the images appear further apart above and below.

By Scheiner's experiment, which consists in looking at any small object, through, say two pin-holes in a card, placed so close to each other as to be included in a space not larger than the diameter of the pupil, a corresponding number of the manifold images of the pin are eliminated from the rest and seen pretty well defined. That is, supposing the person has lost the power of adjustment, and the pin is held at a distance further off or nearer than that of his distinct vision. When held at the distance of his distinct vision, the person sees the pin single and well defined.

Uniocular polyopia is to be distinguished from double vision with two eyes. The latter is owing to a loss of correspondence in the direction of the axes of the two eyes, and, even if there be no evident squint, it is at once distinguished by closing one eye, when the object looked at will be seen single if the open eye be in a state of adjustment corresponding to the distance at which the object is situated.

16th.—*Chromatic vision.*

The coloured vision to be noticed here is to be distinguished from that dependent on subjective excitement of the retina to be considered below, in Section I. of the next chapter (p. 521, et seq).

Although the eye, strictly speaking, may not be perfectly achromatic, it is so in a healthy state to all intents and purposes; but in certain morbid states, its optical parts may become so suffused and deranged as to decompose the light, and make objects appear as if surrounded by the colours of the rainbow, thus:—

1st. In puromucous inflammation of the conjunctiva, films of mucous suffusing the cornea give rise to the appearance of iridescence around objects (p. 159).

2nd. When there is defective adjustment of the eye, and when, consequently, the rays of light do not fall in foci on the retina, vision, at the same time that it is thus rendered indistinct, and even multiplied, may appear slightly iridescent. Hence iridescence around objects is seen when the adjusting power of the eye is disturbed by passion, mental abstraction, sleepiness, the action of belladonna, mydriasis. Hence, also, persons who have one eye myopic and the other hypermetropic often see colours when they look at very near or very distant objects with both eyes, because one eye only is adjusted to the distance of the object.

17th.—*Unequally refractive state of the two eyes.*

The two eyes may be in different degrees myopic or hypermetropic; or one may be emmetropic, and the other myopic or hypermetropic; or one may be myopic and the other hypermetropic.

When the two eyes are still capable of being used in concert in binocular vision, though in different degrees myopic, a concave glass of the same focal length for each eye, will, in general, be found best. A trial may, however, be made of glasses each of a different focal length, if the required difference be not very great.

When, under similar circumstances, the two eyes are in different degrees hypermetropic, convex glasses of different power may in like manner be tried.

When one eye is emmetropic and the other myopic, though the eyes might admit of simultaneous use in binocular vision, a concave glass to the myopic eye would not in general be practically useful.

When one eye is emmetropic and the other hypermetropic, a similar remark applies to the use of a convex glass to the latter.

Should there be squint, and the eye in habitual use requires optical assistance, it may be fitted with a glass irrespective of the optical condition of the other.

When, with one eye myopic and the other hypermetropic, there is absence of binocular vision,—perhaps squint,—the eyes are used alternately—the myopic for near objects, and the hypermetropic for distant. In such a case, each eye in its own sphere requires to be assisted with a glass, the myopic eye with a concave, the hypermetropic with a convex glass.

A gentleman was in the habit of using one eye only, and that was myopic. The other eye he always looked upon as useless. The sight of the former eye having failed him, he consulted me. The cause of this failure of sight I discovered to be detachment of the retina. On examination of the other eye I found it to be hypermetropic, but otherwise sound, and quite fit, with the help of two pairs of convex glasses, to take the place of the other—one pair for looking about with, another pair of higher power (about six inches focus), for reading with.

18th.—*Convex and concave spectacle glasses.*

Convex glasses are distinguished and designated by their focal length. Convex glasses of the lowest power in common use have a focal length of sixty inches, forty-eight inches, thirty-six inches, thirty inches, twenty-four inches. Those of medium power have a focal length of twenty inches, eighteen inches, sixteen inches, fourteen inches, twelve inches. Those of the highest power have a focal length of ten inches, nine inches, eight inches, seven inches, six inches, five and a half inches. Cataract glasses have a focal length usually of four and a half inches for looking about with, and two and a half inches for reading with.

Concave glasses have been hitherto in this country distinguished and designated by arbitrary numbers; abroad they are more generally distinguished by their negative focal length, that is, the focal length of the convex glass, which with it would form a combination equivalent to a plane.

The following are the numbers and their corresponding focal lengths, as found in the opticians' shops in London :—

No.	Inches.	No.	Inches.
00	36	9	7
0	30	10	6
1	24	11	5
2	20	12	4½
3	16	13	4
4	14	14	3½
5	12	15	3
6	10	16	2½
7	9	17	2¼
8	8	18	2

19th.—*Cylindrical lenses.*

Convex cylindrical lenses have the form of a segment obtained on cutting a cylinder by a plane parallel to its axis. *Concave cylindrical lenses* have the converse form, or such as would be produced by grinding on a cylindrical surface.

Two convex cylindrical lenses being placed with their plane surfaces in contact, and so disposed that straight lines parallel to the axis of the cylinder drawn on the convex surface of one, may be at right angles to lines similarly drawn on the other, form a combination possessing the same refractive qualities as a common convex lens. Concave cylindrical lenses similarly combined, form a lens equal to an ordinary concave.

Convex and concave bi-cylindrical lenses are made by grinding the opposite surfaces of the form and in the relation described. The surface with the vertical axis should be next the eye. If the radius of curvature of one of the cylindrical surfaces be made longer or shorter than that of the other, we have a distigmatic lens. But the simplest form of a distigmatic lens is that above described in the article distigmatism or astigmatism, p. 502.

20th.—*Prismatic glasses.*

Prismatic glasses are formed either with perfectly plane, or in combination with convex or concave surfaces, inclined towards each other at an angle varying from 3° to 24°. These glasses placed before the eyes with their angles next the nose, for instance, throw the binocular images inwards, and thus force the eyes involuntarily to converge more, in order to correct the diplopy which tends to take place; and *vice versâ.*

What led to trying prismatic glasses was a declination of the visual lines. The idea of making it possible to look with both eyes, in spite of this declination, occurred first to Dr. Krecke of Utrecht, whose idea Dr. Donders has endeavoured to realize and explain physiologically.

Prismatic glasses may be used to correct the diplopy arising from slight incurable declinations of the visual lines, outwards, upwards or downwards, or to relieve the muscular asthenopia depending on insufficient power of the internal recti. In paresis of a muscle, they make the double images which have been brought near one another to run together.

If the two convex glasses of a pair of spectacles have their centres nearer each other than the centres of the pupils before which they are placed, the images of the objects appear to both eyes displaced more outwards, and thus less convergence is required. The reverse is the case when the centres of the glasses are further from each other.

The converse of all this of course takes place, when concave glasses are used.

In either case, the change of convergence required is less, the weaker the glasses are and the less they are pushed to the side. The use of such eccentric positions of the glasses has been recommended in cases of weakness of one or other muscle in which a combination with a weak prism is otherwise indicated.

On this point the following observations from M. Giraud-Teulon are taken from the French edition of this work, p. 509.

Suppose the centre of the convex glasses of a pair of spectacles be opposite each pupil, the object to which the two eyes are directed gives to each eye a virtual image projected at a greater distance than the real position of the object. The place occupied by these images is, moreover, for each eye, on the prolongation of its optic axis towards the object. Unless the eyes or the instrument corrected this relation there would therefore be crossed diplopy. Now, as the glasses are supposed to be in relation to the pupils centre for centre, everything is symmetrical on their part. As, on the other hand, the object is not seen double, it must be the eyes, which, by their own proper power, have overcome the theoretica diplopy and effected the fusion of the double virtua images. And as the diplopy is crossed, this correctio can have taken place only by mutual convergence of th optic axes.

There is thus a decided disassociation between th degree of the accommodation for distance or virtua monocular adjustment, and that for position or binocula adjustment.

The inconvenience arising from the use of convex glasses centre for centre becomes, *à fortiori*, greater when we look through the regions of the same glasses acting as prisms with their summit next the nose. The disaccord observed in the first case, increasing with the value of the angle of deviation of the prism, this carries still more inwards the real effective ray which has emanated from the object.

But it is quite otherwise with the external prismatic regions. If the two eyes look through the external prismatic regions of the convex glasses, they are relieved of the labour of causing the fusion of the theoretically double virtual images. The two adjustments of distance and position are brought into accordance by the glasses themselves, and the extent of the binocular vision with glasses is identically the same as that of monocular vision.

It thus follows that the integrity of the sight of the presbyopic emmetropic person requires that there should be between the centres of the convex glasses of his spectacles a distance notably less than the greatest distance between the centres of the pupils.

Inversely of what has been said in regard to convex glasses, the work performed by myopic eyes with concave glasses produces a movement of divergence of the optic axis.

If the internal prismatic regions of the concave glasses turn the ray outward, the external prismatic regions turn it inward and correct the interruption of harmony mentioned. These parts of the glasses acting simultaneously reestablish the accord between the two accommodations. The conditions of binocular vision are thus absolutely resolved into those of vision with a single eye, and the field of distinct vision preserves the same extent.

In order to establish the requisite accord, it is sufficient to cut off the inner half of each glass—whether concave or convex—and so place the outer half that its centre shall be opposite the centre of the pupil.

This is easily done by cutting a lens in two and setting the halves in the spectacles each opposite the other.

SECTION II.—VISION OF OBJECTS IN AND ON THE EYE.*

Under certain circumstances, one may see objects in or on his own eyes. The appearance constitutes what is commonly known by the name of *muscæ volitantes.*† Under this name, however, certain other morbid appearances are often also included, which are not owing to the visual perception of any object in or on the eye, but are entirely subjective; are owing, for example, to insensible spots of the retina. Such appearances as the latter have no real motion, but apparent motion only, depending on that of the eye; hence they are distinguished by the name of *fixed muscæ* from the former appearances, which present real as well as apparent motions.

VISION OF OBJECTS IN THE EYES.‡

1st.—*Common muscæ volitantes.*§

Muscæ volitantes appear to the patient who has made no particular examination of them, under the form of blackish motes, or of a thin gray film, like the wing of a fly, or of semi-transparent gray threads, like spiders' web, but if viewed attentively against the clear sky, a white wall, or the like, they are recognised to be made up of appearances such as the following:—1st. A convoluted string of beads, or a convoluted transparent tube, containing in its interior a row of beads smaller than its diameter, except here and there where one larger than the rest is seen occupying its whole diameter, the end of the string or tube sometimes presenting a dark knobbed extremity, as if formed by an aggregation of the beads composing the string, or contained within the tube (Fig. 133, *a*); 2nd, Insulated beads, some of which, and these the more frequent, have a well-defined outline (*b*) — others, and these rarer, have an indistinct outline (*c*); and, 3rd, a parcel of flexuous round watery-looking or spun-glass-like filaments with dark contours, often divided inferiorly into truncated branches (*d*).

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* Mackenzie, in Edin. Med. and Surg. Journal, No. 164, 1845. Jago on Entoptics, London, 1864.

† Spectra, Scotomata, Myodesopia, &c.

‡ Entoptics.

§ Floating muscæ—Entohyaloid muscæ.

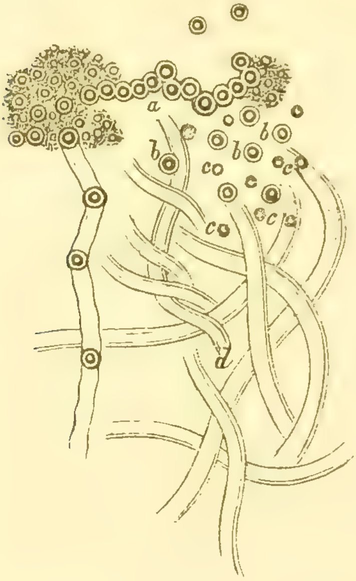

Fig. 133.

These different appearances may be seen altogether, the beaded appearance on one side of the parcel of watery-looking filaments, and interspersed here and there the insulated beads, one or two of the well-defined of which often appearing as if attached to the outside of the beaded tubes; or some one of the appearances may be seen principally or exclusively.

According as the distance of the object against which the muscæ volitantes are viewed is greater or less, they appear larger and fainter, or smaller and more distinct.

Vision is not affected by floating muscæ. Between the several portions of the muscæ and by the side of them, the eye still sees everything with perfect distinctness. Even the portions of the retina, over which the shadows which cause the appearance of the muscæ fall, are found by the patient, when the corpuscles ascend out of the field of vision, to be perfectly sensible.

Muscæ volitantes are often detected suddenly, and thus are supposed to have just occurred. They are most observed when the patient looks at the clear sky, a thin cloud, snow on the ground, a white wall, or the like.

They are not much, if at all, noticed under the opposite conditions of a dull light, and looking at a dark object. They are indistinct when near objects are looked at.

They are rarely seen in the axis of vision, but generally to one or other side, or above or below. The patient, thus seeing them only by a side glance, finds it difficult to fix them in order to study their appearance. They move as the eye moves upwards and downwards, or from side to side; but besides this motion, which, as dependent on that of the eye, is merely apparent, the muscæ have a real motion of their own, and still more extensive than their apparent motion. Thus, if from looking before him in a horizontal direction, the patient suddenly raises his eyes and fixes them on some object above the horizon, he observes that the muscæ fly upwards considerably beyond that degree of elevation, and even beyond the field of view, and then come sailing down before him till they disappear below.

Besides the motions of ascent and descent, the muscæ volitantes under consideration present lateral movements, although less marked, as well as changes in the relative positions of their several parts.

Nature of floating muscæ.—Hitherto a very common opinion as to the nature of floating muscæ has been, that they are subjective sensations, depending on some intrinsic change of state of the optic nervous apparatus, thus confounding them with fixed muscæ; but that they are truly objective sensations, occasioned by the presence of particles in the interior of the eye, throwing their diffracted shadows on the retina, admits of mathematical demonstration.

Without entering minutely into the matter, the proposition may be easily illustrated thus:—Hold between a convex lens and the white surface on which the image of the light falls, some small object, as a pin. When this is near the lens, its shadow is not seen on the white ground, but when it is brought nearer and nearer the white surface, its shadow appears more and more distinctly.

The particles, moreover, appear to be of normal occurrence in the eye, for the appearance of floating muscæ may in general be seen by any person by simply looking through a small aperture in a card at the clear sky, or through the eyepiece of a compound microscope at the flame of a candle two or three feet distant, or simply by bringing the eyelids towards each other, and looking at a lighted candle.

On contemplating the spectra thus brought into view, viz., the beaded filaments, the distinct and indistinctly defined globules, and the watery-like filaments, called by Dr. Mackenzie respectively the *pearly spectrum*, the *distinct insulo-globular spectrum*, the *indistinct insulo-globular spectrum*, and the *watery spectrum*, it is observed that they are situated in different planes, one behind the other, "that they never mingle with one another, so as to change the order in which they stand before the eye; but the pearly spectrum always appears the nearest, then the sharply-defined insulo-globular, then the obscurely-defined globules, and farthest away the watery threads."

Seat of the particles, the presence of which occasions muscæ volitantes.—This admits of being mathematically demonstrated to be in front of the retina, in or behind the vitreous body, but at the same time it appears that it is different for the different kinds, being in almost immediate proximity with the retina for the pearly spectrum, and farthest from the retina for the watery spectrum.

The particles being seated behind the focal centre of the eye, their movements are seen inverted. Moving actually upwards, they appear to descend.

Nature of the particles, the presence of which occasions floating muscæ.—This has not yet been with certainty determined. In the vitreous humour (as also in the aqueous) there is contained a great number of corpuscles, most of them resembling lymph corpuscles, though smaller, being between 1-4000th and 1-5000th of an inch in diameter; but it appears from the calculations of Brewster, Mackenzie, and Ruete, that the size of the particles, the presence of which occasions floating muscæ, is much greater than this.

Muscæ volitantes are often seen by persons without any particular notice of them being taken, as they are indistinct, present themselves occasionally only, and are therefore not troublesome.

They are seen most distinctly, and are therefore most troublesome, when there exists an irritable state of the retina, with weakened irradiation (p. 525, et seq.). Such a state of the retina may therefore be viewed as the general condition on which floating muscæ, considered as a disease, depends.

Dilution of the images of external objects favours, distinctness, on the contrary, prevents, the perception of muscæ. Hence, when the person is short or far sighted, they appear less evident to him when he uses the glasses fitted to render his vision distinct. This appears to be owing to the stronger impression of the external objects making up for the weakened irradiation, so that the weak impression of the objects of the muscæ is more readily effaced.

The pupil of an eye affected with muscæ volitantes is generally contracted, even when the eye is myopic.

Exciting causes.—Over-use of the eyes on minute objects;—Inflammatory diseases of the eyes, external as well as internal;—The seeking for them in experiments;—Febrile diseases;—Influenza;—Disease of the heart;—Want of sleep;—Dyspepsia;—Abdominal congestion;—Hysteria;—Hypochondriasis;—Morbid sensibility of the system generally, arising from pressure of business, anxiety, and distress of mind. All these causes appear to operate in the same manner, occasioning a congested state of the eyes, and weakened irradiation of the retina.

When a hypochondriacal person once detects muscæ volitantes, he takes such frequent notice of them, that they become to him more and more troublesome.

Prognosis.—From what has been said, it will be seen that the occurrence of floating muscæ is of itself no indication that either cataract or amaurosis is taking place. If, however, there be along with the appearance of muscæ a failure of vision, and if that failure be not attributable to myopy or presbyopy, which may be ascertained by a concave or a convex glass not improving vision, then cataract or amaurotic amblyopy may possibly exist.

In uncomplicated cases, the muscæ may indeed increase in numbers, but very slowly, and never to such an extent as to interfere with the distinctness of vision in any very troublesome degree. But sometimes the muscæ remain stationary, or even become less.

As they depend on the vision of objects naturally existing in the eye, in consequence of a morbid sensibility of the retina, whatever tends to promote or relieve this will have the effect of promoting or relieving the muscæ.

The particles on which the appearance of muscæ volitantes, as above described, is supposed to depend, are too minute to be detected by the ophthalmoscope. In certain cases of exaggerated muscæ, however, accompanying a morbid state of the posterior segment of the eyeball, we have above seen that membraneous and filamentous shreds are seen moving up and down in the vitreous humour (p. 60).

Treatment.—The removal or abatement of the exciting cause, if it can be detected, is the first thing to be looked to. Rest to the eyes, if they have been overstrained, relaxation from business, quiet to the mind. When the stomach and liver are out of order, mercurial alteratives, followed by tonics, regulated exercise, and change of air. Cold applications to the eyes, such as the cold douche bath (p. 76) twice or thrice daily, for five or ten minutes, is the most important local application.

2nd.—*Spectrum of the vascular ramifications and network of the retina.*

This may be seen by means of the following experiment, which, from having been first pointed out by Professor Purkinje, is commonly called the experiment of Purkinje. It consists in shading, without closing, one eye, and looking straight forward with the other, whilst a lighted candle (the room being otherwise dark) is moved up and down close to the eye on the temporal side. In a short time a magnified spectrum of dark ramifications and anastomoses, on a light ground, appears floating before the eye, moving in a direction opposite to the movements of the candle.

In this experiment those parts of the retina covered by the ramifications of the central vessels not being so much excited by the light as the rest of the membrane, do not retain the impression so long as until the return of the candle; hence the appearance of dark ramifications in the field corresponding to those parts.*

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* A spectrum of the vessels of the retina is, in certain states of the eye, seen independently of external light—light on a dark ground; but this is owing to pressure on the retina by the vessels. Being thus a subjective phenomenon, it belongs to the head of *photopsy.*—See next chapter. The appearance above referred to in p. 132, is similar to the vascular spectrum, but is owing to insensibility of the retina, from the pressure and opacity occasioned by the congestion and exudation in inflammation of the vascular layer of the retina. This, therefore, also belongs to the next chapter—to the head of *fixed muscæ.*

3rd.—*Circulatory spectrum.*

An appearance of grayish watery-like particles darting in every direction before the eyes, somewhat like the circulation in the web of the frog's foot under the microscope, may be seen by a healthy eye, by gazing at the clear sky for a short time. If the eyelids are shut, the particles are seen dark red. This is an objective sensation, produced probably by the shadows on the retina of the blood corpuscles circulating in its vascular layer.*

Sitting opposite a window into which the sun is shining, and keeping my eyelids passively closed, I can see, after watching for a few seconds, an appearance of the circulation of the blood, such as might be supposed to be presented under the microscope. The arterial stream is recognised by its straight and rapid course; the capillary streams by their intricate meanderings and reunions; the streams in the venous radicles by their equable flow and sinuous windings. On now covering my eyes with my hand, this appearance ceases, but I retain a sensation such as we have after looking on objects in motion.

VISION OF OBJECTS ON THE EYES.

Muco-lacrymal muscæ.

Sometimes, though rarely, appearances are seen like opaque round spots, surrounded by a halo, which occasionally seem to run together, and again divide, and which slide downwards, but re-ascend after every nictitation.

These appearances are produced by the shadows on the retina, of minute globules of air in the mucous and tears covering the cornea. They are therefore called by Dr. Mackenzie, muco-lacrymal muscæ volitantes.

The objects being in front of the focal centre of the eye, their movements are not seen inverted.

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* When one stoops and then suddenly rises, the appearance of showers of lucid globules before the eyes is of a different nature, being a subjective sensation, excited by pressure on the retina by the determination of blood. So also is an appearance similar to that above described, except that the particles are lucid. The appearance of lucid spectra, therefore, belongs to the head of *photopsy.*—See next chapter.

CHAPTER V.

AMAUROTIC AFFECTIONS,

OR DEFECTS OF SIGHT DEPENDING ON PERVERTED, IMPAIRED, OR LOST SENSIBILITY OF THE OPTIC NERVOUS APPARATUS.

SECTION I.—INTRODUCTION.—ABNORMAL EXCITEMENT OF VISUAL SENSATIONS.

IN amaurotic affections, various visual sensations, though not in themselves unnatural, are liable to be excited unnaturally. Such sensations being important as symptoms, it is necessary to study them: but previously to doing so, the circumstances attending their natural occurrence must in each case be taken into consideration.

1st.—*Photopsy and Chroopsy, or sensations of light and colour, independent of external light.*

In the unexcited condition of the optic nervous apparatus, there is darkness before the eyes, but in the excited condition, the sensations of light and colour are experienced.

The sensation which we perceive in consequence of an impression on the eye, we denominate *light*: and the external agent, which commonly makes the impression, we also call light. But the sensation, and the external agent which by its impression on our eye excites in us the sensation, are totally different things. The external agent, light, considered in itself, is not clear, nor yellow, nor red, nor blue; it is merely the undulations, different in size and rapidity, of a universally distributed and excessively tenuous imponderable ether.

That the sensation of light depends solely on the peculiar energy of the optic nerves, and not on the nature of the agent which impresses them, is proved by the fact that the sensations of light and colour may be called forth by other influences, such, for example, as pressure. And it is to be observed, that whatever may be the stimulus which excites the optic nervous apparatus, no other sensations but light and colour can be called forth in it.

As nervous primitive fibres are throughout their whole course physiologically the same, it is indifferent what part of the optic nervous apparatus be excited in order that luminous sensations may be perceived—whether the retina itself be irritated, the fibres of the optic nerve in the orbit irritated or cut, or whether the cerebral part of the optic nervous apparatus be pressed on by congestion or tumour. As, moreover, the activity of nervous fibres is always manifested at their peripheral extremities, so in whatever part the optic nervous apparatus be excited, the luminous sensation which results is always referred by the sensorium to the periphery; not only to the periphery, however, but as in natural vision to without the body—(*projection outwards*).

A familiar example of a luminous spectrum of the kind under consideration is that which, on pressing the eyeball, is seen projected outwards, and on the side opposite to that where the pressure is applied.

In illustration of how liable people are to mistake the sensation of light excited by other agencies besides that properly called light, for the agent itself, the following case is adduced:

Some years ago, in Germany, a clergyman was assaulted one dark night by two men, one of whom struck him on the right eye with a stone. By the light which streamed from his eye, in consequence of the blow, the clergyman averred that he was enabled to see and identify the man who committed the outrage.

The question whether this was possible was actually raised in the criminal investigation, and the official district physician was referred to for his opinion. That gentleman, without fully admitting the possibility of what the clergyman alleged, still thought that there was some probability in it.

The late Professor Müller, of Berlin, commenting on this singular case, sarcastically but justly observed, that if the district physician had given himself a blow on the eye in the dark, and then tried to read by the light thereby emitted, he would probably have come to a more decided conclusion.

Though the changes operating on the brain, whereby we are rendered conscious of sensations, are usually the result of the communication of impressions on the nerves of sense made by external agents, such changes in the state of the brain may be the result of the communication of changes in the state of the nerves of sense induced by impressions made by some agency operating within them, or they may be primarily induced by some cause directly operating within the brain itself.

Examples of this are—1st, a spectrum of the vessels of the retina, *light on a dark ground*, which, in certain states of the eye, is seen, and which is owing to pressure on the retina by its vessels in a state of congestion;* 2nd, the appearance of a shower of lucid globules before the eyes on suddenly rising from a stooping posture, from the disturbance in the circulation in the optic nervous apparatus thereby occasioned.

Analogous appearances of fiery scintillations, flashes of light, and coloured corruscations, occurring spontaneously, are symptoms of irritation or excitement of some part of the optic nervous apparatus—cerebral or ocular—from inflammatory congestion; when ocular, from inflammatory congestion of the choroid, as above mentioned (p. 132), rather than from inflammatory congestion of the retina. As such inflammatory congestion may end in amaurosis, so the luminous and coloured spectra are symptoms of incipient amaurosis. They may continue to appear, however, after all visual sensibility is lost.

Sensations of light from such a cause operating within the body may be mistaken by ignorant or weak-minded persons for sensations actually excited by light, as in the following case:—

A woman, deaf for some years, and troubled with noises in her head, became subject to photopsy also: and fell into the hallucination of supposing that people had everywhere conspired to annoy her by throwing glares of light into her eyes. I found it impossible to convince her of the real nature of her complaint. Her intellect was evidently impaired from the same disease of the brain to which the noises in the head and the photopsy were owing.

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* The difference between this and the spectrum in Purkinje's experiment is above explained.—See note, p. 516.

Sensations of colour of the kind just considered are to be distinguished on the one hand from those which depend on an optical derangement in the eye itself, whereby its achromatism is destroyed (p. 505, et seq.), and on the other from accidental or complementary colours, considered in the next article.

2nd.—*Spectra from the retention of visual sensations.—Complementary colours.*

In the natural state, the sensations of the retina remain a short space of time after the impression which occasioned them has ceased to act. Hence, an image of an object may continue to be seen for some seconds after the eyes have been turned away from looking at it. This phenomenon is, in general, most readily observed in twilight; in daylight, the impression of the object on the retina requires to have acted more intensely and a longer time to produce the effect.

The spectrum appears when the eyes are directed to the sky, projected in the distance, and of gigantic size.

The spectrum is seen differently, according as the eyes, when turned away from the object, are darkened or directed to an illuminated surface. In the former case, the lights and shadows are the same as appeared at the time of regarding the object (*positive spectrum*); in the latter, they are the reverse (*negative spectrum*).

If the object from which the impression has been derived is coloured, the spectrum is coloured also, but differently, thus:—If the eye be fixed on a red coloured object for some time, and then turned away from it, a spectrum of the object will continue to be seen, but instead of a red, of a green colour. If, on the contrary, the object looked at be green, the spectrum will be red; again, if blue, the spectrum will be orange; if orange, the spectrum will be blue; if yellow, the spectrum will be violet; if violet, the spectrum will be yellow.

From this it is seen that the colour of the spectrum is always that which being added to the colour of the object looked at, makes up the sum of the prismatic colours, yellow, red, and blue, which by their combination, form white light; hence, the name complementary which has been given to the colour of the spectrum.

In the annexed figure the primary colours, yellow, red, and blue* are placed at the angles of the triangle, the compound colours, orange, violet, and green, at the intermediate points.

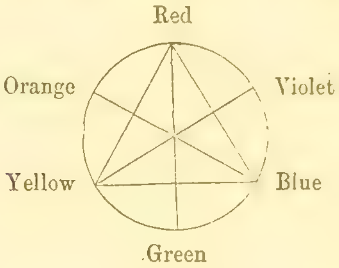

FIG. 134.

The primary colour and the compound one, which thus stand opposed, viz., yellow and violet, red and green, blue and orange, are complementary of each other.

A spectrum is very readily produced, by looking at the setting sun. If on turning the eyes away they are darkened, the colour of the spectrum is at first luminous white: it then changes to yellow, and from that runs through the different colours of orange, red, violet, blue, to black, when the spectrum ceases. If, on the contrary, the eyes are directed to a white surface, the spectrum is at first black, then blue, which colour is succeeded by violet, red, orange, yellow, until the spectrum, becoming white, is no longer distinguished.

In certain morbid states of the retina, even although vision be much impaired, the sensation remains after the impression a much longer time than natural; hence arise illusions of vision from the spectrum and complementary colours. In such a case, for example, if the person, after his eye has rested on some small and near object, the tassel of a blind for example, should accidentally look towards the sky, he will see a magnified image of it; but not aware of the cause, he is astonished by what appears to him, a gigantic human figure in the air.

Spectra from the retention of visual sensations have, no doubt, constituted the foundation of many stories of apparitions.

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* Whether yellow, red, and blue be primary colours—whether green is not primary—whether yellow is not compound—are questions which it is not necessary to enter into here.

3rd.—*Phantasms.*

Besides spectra from after-visual sensations, there is another class of apparitions, which have their origin in the re-action of the mind on the senses. To this class belong *phantasms.*

Phantasms of touch are exemplified in the pains of hypochondriacs. In regard to phantasms of hearing, people sometimes imagine that they hear not only sounds, but spoken words. The phantasms of vision are those, however, which have attracted most interest. Appearances as if of various objects—landscapes and figures, for example, even walking figures,—present themselves before the eyes. Nay, phantasms of both hearing and vision may occur together—the human figures seen being, at the same time, heard talking. In the celebrated case of Nicolai, the Berlin bookseller, the phantasms were at first *seen only*, but after a time they were *heard also.*

Phantasms are of most common occurrence in disease, under the influence of opium and other narcotics, in delirium tremens, and in insanity; but they may appear to persons otherwise healthy, though in an excited state either from original temperament, or in consequence of being placed in exciting circumstances. And, of course, exciting circumstances will operate more strongly on a person already excitable from original temperament. In some persons there is a natural disposition to phantasm-seeing.

The mental state excited by some strong impression, or by long brooding on a cherished scheme, may, by its re-action on the senses, give rise to a vivid production of phantasms relating to the predominating idea.

This is exemplified by Shakspere, when he makes Macbeth exclaim:

> "Is this a dagger which I see before me,
> The handle toward my hand? Come, let me clutch thee:
> I have thee not, and yet I see thee still."

We have a similar example in Brutus—"midst his slumbering host, startled by Cæsar's stalwart ghost."

Phantasms occurring in persons of strong mind and cultivated intellect are recognised as such. This was the case with Nicolai, referred to. The arguments used by the epicurean Crassus, to tranquillise the mind of hi friend Brutus, after being startled by the apparition o Cæsar, showed that he took a correct view of the matter attributing the phenomenon solely to the imagination and Shakspere makes Macbeth raise the question, when he adds to his first exclamation :

> "Art thou not, fatal vision, sensible
> To feeling, as to sight? Or, art thou but
> A dagger of the mind ; a false creation,
> Proceeding from the heat-oppressed brain ?"

In the case of persons of uncultivated intellect, phantasms have, no doubt, been the origin of many ghost stories. Whilst in weak-minded persons, not otherwise actually insane, they may lead to hallucinations prompting to insane actions.

Every one has heard of the phantasms induced by the use of opium, and the still more remarkable ones excited by Hashish, or Indian hemp—the drug said to have been used by the sect of Assassins, under the blow of one of whom, Conrad, Marquis of Montferrat, one of the leaders of the Crusaders, fell, to raise phantasms, and thereby incite themselves to their violent deeds—hence the name Assassin—those who indulge in the use of Hashish being to this day called in Arabic, Hashishin, or Hashashin.

The occurrence of phantasms in insanity has been mentioned, but it would be out of place here further to refer to them.

I come, in the last place, to notice the phantasms on which has been founded a belief in "second sight."

That kind of second sight referred to by Campbell, in the following lines:

> "'Tis the sunset of life gives me mystical lore,
> When coming events cast their shadow before:"

is, after all, a natural enough kind of second sight, and one which we all acquire more or less by the experience of life.

Persons said to have been endowed with "second sight" among the Scotch Highlanders, appear to have been of excitable temperament and deeply contemplative character. Alan Macaulay, in Sir W. Scott's "Legend of Montrose," is a good example. Such a person, having his mind intently and anxiously fixed on some stirring enterprise, may readily be supposed, when wrought up to a paroxysm of excitement, to have had presented to his mind's eye, and with all the distinctness of reality, a possible combination of events. In any case, when the events turned out in the combination predicted by the seer, the vision was received as supernatural, and the case was treasured up in the memory of those concerned. But when the events did not correspond to the prediction, the failure, as generally happens in unsuccessful cases, was unnoticed and forgotten.

4th.—*Reciprocal action of the different parts of the retina on each other's sensations.*

Participation of the different parts of the retina in each other's sensations or irradiation of sensations.—Any one fibril of a sensitive nerve may be in action alone. But it is possible for fibrils in a state of activity to communicate a similar state to neighbouring ones. This, which is effected at the central extremities of the fibrils, and of which the result is an extension of the original sensation, is called irradiation of sensations.

The retina is prone to such irradiations of sensations. Thus, if the eye be kept fixed for some time on a small strip of coloured paper, lying on a sheet of white, the strip will after a time vanish for a moment. The circumferential part of the retina is more prone to irradiation of sensations than the middle part, but at the entrance of the optic nerve it is most so; in fact, the well-known vanishing of images at this part in Marriotte's experiment is an exemplification of irradiation. It appears to be owing to irradiation that the spectrum of the retinal vessels is not in the ordinary exercise of vision seen.

An insensible spot of the retina, if small, may in consequence of irradiation not be seen, or at least not constantly seen, as a fixed musca.

On the other hand, weakened irradiation, which is an accompaniment of diminished sensibility of the retina, allows of small insensible spots of the retina to be more readily seen, as fixed muscæ; and appears to be the condition on which ocular spectra and complementary colours from retention of retinal sensations to a morbid degree, as well as muscæ volitantes (p. 514), depend.

Excitement of opposite conditions in contiguous parts o the retina.—A state of activity of one part of the retina instead of exciting a similar, may excite an opposite state. Thus, as is well known, the brighter the light, the deeper the shadow. Another example is presented by the following experiment:—A small strip of grey paper lying on a sheet of red, after the eye has been fixed on it for some time, appears of a green colour, the complementary colour of the red ground.

In accordance with this law, an insensible spot of the retina, if large, occasions more distinctly the appearance of a black spot in the field of vision, or a fixed musca, the brighter the light.

SECTION II.—IMPAIRMENT AND LOSS OF SENSIBILITY OF THE OPTIC NERVOUS APPARATUS, OR AMAUROSIS IN ITS VARIOUS DEGREES.

The sensibility of the retina is greatest in the region of the yellow spot (not in the situation of the foramen centrale, as shown by Herschel, but to one or other side of it). From thence the sensibility diminishes towards the ora serrata.

In consequence of this, we see only that part of an object very distinctly to which the axes of the eyes or visual lines are at the moment directed. In examining an object, the eyes are so moved that the central region of the retina may be successively impressed by the image of its different parts.

The difference in the degree of sensibility of the middle and circumferential parts of the retina may be illustrated by a reference to the difference in the degree of sensibility of the skin of the lips for example, and the skin of the cheeks. Whilst the points of the two legs of a pair of compasses, when separated a very short distance from each other, are applied to the skin of the lips, the mind distinguishes the two impressions; but when applied to the skin of the cheek, there is no distinct perception of two points, but a sensation as if one impression only were made.

As impressions on the less sensitive skin of the cheek are perceived, as if smaller than impressions on the more sensitive skin of the lips; so objects seen by the less sensitive circumferential part of the retina appear smaller than when seen by the more sensitive middle part; or, *ceteris paribus*, an imperfectly illuminated object appears smaller than one brightly illuminated.

In amblyopy, objects appear smaller than natural owing perhaps to the defective sensibility of the retina (*amaurotic micropy*).

1st.—*Daltonism,* or colour-blindness.*

Cases occur, and that more frequently than is generally supposed, in which persons are unable, in different degrees, to distinguish certain colours, their sight in other respects being unimpaired. The colours most generally confounded are red and brown with green, and pink with blue. Yellow and blue are generally readily distinguished by the colour-blind.

The affection appears to be in most cases congenital.

Acquired colour-blindness, however, sometimes presents itself as a symptom of incomplete amaurosis. Yellow discoloration of the lens I have found not to interfere with the correct perception of colours. Santonine, a crystalline substance obtained from worm-seed, has the curious property, when taken internally, of causing everything to look pea-green.

Colour blindness has been detected much oftener in males than in females. It runs in families, and, like other hereditary complaints, it sometimes overleaps one generation or more.

The most important practical disadvantage attending it is, as has been pointed out by Dr. Wilson, the possibility of confounding red and green signals on railways or at sea, a mistake which might entail most disastrous consequences.

Congenital colour blindness is incurable. There are, however, some methods of alleviating or correcting the false judgments which the imperfect sense is led into. One is the *comparison of doubtful with known colours*, by carrying about a chromatic scale, accurately tinted and named. This, however, is available only to a limited extent—that is, as far as the colours of the scale itself can be distinguished. Another, is the *employment of touch* to distinguish the differences in texture made by different dye-stuffs. This may be of some use to drapers, weavers, &c., but would not assist a person in purchasing unknown articles. Perhaps to painters the *sense of smell* might be a help, and would not be open to the obvious objection to the employment of the *taste.*

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* So named from Mr. Dalton, the author of the atomic theory in chemistry, who had the defect of sight in question, and was the first to write on the subject. See "Memoirs of the Literary and Philosophical Society of Manchester. 1798."

A more important method, indicated by Dr. Wilson, is the substitution of artificial for solar light in the examination of colours. It is certainly a strange thing, that candlelight, which to the healthy eye causes a confusion of delicate tints, should render them more easily distinguishable by a morbid sense. Such, however, appears to be the case, as several examples adduced by Dr. Wilson show.

To guard against accidents from mistaking the colour of signals on railways or at sea, Dr. Wilson suggests two remedies. First, a careful examination of the employés to test their capability of distinguishing rapidly and correctly the signals used; and secondly, to make the shape and movements of signals the chief index of their meaning, so as to dispense with colour except as a subordinate aid.*

2nd.—*Transient hemiopy.*

The following is an account of Hemiopy, by Dr. Wollaston, as it occurred in his own person:—"I suddenly found, after violent exercise two or three hours before, that I could see but half the face of a man whom I met; and it was the same with respect to every object I looked at. In attempting to read the name JOHNSON over a door I saw only SON; the commencement of the name being wholly obliterated to my view. The loss of sight was towards my left, and was the same, whether I looked with the right eye or the left. This blindness was not so complete as to amount to absolute darkness, but was a shaded darkness, without definite outline. The complaint was of short duration, and in about a quarter of an hour might be said to be wholly gone, having receded with a gradual motion from the centre of vision obliquely upwards towards the left."

More than twenty years subsequently, a similar attack occurred again, without Dr. W. being able to assign any cause whatever, or to connect it with any previous or subsequent indisposition. "The blindness," says he, "was first observed, as before, on looking at the face of a person I met, whose *left* eye was to my sight obliterated. My blindness was in this instance the reverse of the former, being to *my right* (instead of the left) of the spot to which my eyes were directed; so that I have no reason to suppose it in any manner connected with the former affection. * * * On this occasion the affection, after having lasted with little alteration for about twenty minutes, was removed suddenly and entirely by the excitement of agreeable news respecting the safe arrival of a friend from a very hazardous enterprise."

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* "Researches on Colour-Blindness." By Dr. George Wilson Edin. 1855.

Such cases are not uncommon. I have myself twice experienced an attack. The first occurred some years ago, in returning from a walk before dinner one hot day in summer. I felt exhausted, languid, and slightly giddy, but in other respects quite well. After dining and drinking a glass of port wine and water, the hemiopy became somewhat alleviated, but did not entirely go off until after tea, having continued two or three hours. The second attack occurred some months ago, in consequence of gastric derangement.

In some persons the affection is of frequent occurrence, coming on along with indigestion, headache, and nausea, but going off in a few hours.

Admitting the doctrine of corresponding parts of the two retinæ as explained in the next chapter, and admitting the structural condition of their correspondence to be, in addition to semi-decussation, of the optic nerves, some continuity between the fibres of the corresponding sides of the retinæ, we may, with Dr. Wollaston, consider the proximate cause of hemiopy to be some temporary affection of the brain at the origin of one or other optic nerve.

Treatment.—According as hemiopy depends simply on fatigue or gastric derangement, so must the treatment be regulated.

The case of a friend of his, which Dr. Wollaston describes, does not appear to have been of this kind, but a case of incomplete amaurosis. The blindness came on after the patient had suffered severe pains in his head for some days, about the left temple, and towards the back of the left eye; Vision continued considerably impaired.

Common amaurosis sometimes presents itself as a hemiopy, in which case, it may be the *right* side or the *left* side of the field of view, or the *upper* half or the *lower* half which is obscured; and so far from coming on suddenly and going off suddenly, this form of hemiopy comes on slowly and continues gradually to extend until the whole field of view is obscured, and that, perhaps, incurably.

*Night-blindness.**

Indistinct vision, recurring regularly at night, has sometimes prevailed as an epidemic. Most frequently it is met with as an occasional complaint, especially in warm countries and warm latitudes at sea. In certain countries it appears to be endemic, occurring in the spring and summer.

In the beginning of the complaint the patient is still able to see objects a short time after sunset, and perhaps to see a little by clear moonlight, and he may see distinctly by bright candle-light. Vision, however, becomes more and more imperfect at night, so that after a few days the patient can no longer discriminate the largest objects after sunset or by moonlight, &c.; and after a longer lapse of time, he ceases to see any object distinctly by the brightest candlelight.

The pupils move naturally during the day, but after sunset they become dilated, and contract sluggishly on exposure to light. Sometimes they are considerably dilated, both by day and night. In cases of long duration the pupils are often contracted, and there are evident manifestations of intolerance of light.

Causes.—The principal causes of night-blindness appear to be fatigue and exposure to the strong light of the sun and gastric derangement; lunar influence is also considered to operate as a cause. I have met with two cases apparently arising from exposure of the eyes to naphtha vapour. The following is one of the cases:—

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* Cæcitas nocturna. The words *hemeralopia* and *nyctalopia* have been differently used by authors; some expressing by hemeralopia night-blindness, and by nyctalopia day-blindness; whilst others have employed the words in an opposite sense.

A lad aged 17. Has been working for the last fortnight with shell-lac, naphtha and gutta-percha. Since then he finds that his sight, which is perfectly good during the day, regularly becomes dim at night.

The occurrence of night-blindness in connection with scurvy, which had been before noticed by authors, was repeatedly exemplified among the soldiers and sailors in the Crimea; and, in the last American edition of this work, it is stated that those who have had the care of soldiers since the commencement of the civil troubles in the United States, can bear witness to the fact that night-blindness has been not unfrequent in cases of scurvy.

Prognosis.—Under proper treatment, the prognosis may be always favourable. The duration of the disease is generally from two weeks to three or six months. If, however, it be neglected or mistreated, vision may become imperfect in the day-time as well as at night. In some cases, the disease has terminated in total blindness.

Europeans who have been once affected with night-blindness, are particularly liable to a recurrence of the complaint as long as they remain in tropical climates.

Treatment.—The remedies to be first had recourse to are those adapted for the removal and alleviation of any general complaint, of which the night-blindness may be symptomatic. If gastric derangement, for example, emetics and purgatives are to be prescribed. If scurvy, the proper diet, of course,—fresh meat and vegetables, if they can be procured. If after the removal or alleviation of the general complaint, the night-blindness has not of itself gone off, a succession of blisters to the temple has been found a most efficacious remedy.

In the cases which have occasionally come under my notice in this country, the most beneficial results have been obtained from the oil of turpentine, in doses of ♏xv to xxx, three times a day, combined with a dessert or table-spoonful of cod-liver oil. The value of an ancient popular remedy has been well attested, viz., the exposure of the eyes to the vapour arising from the liver of the ox. Exposure of the eyes to the vapour of ammonia has also been recommended.

Congenital night-blindness.

Night-blindness is sometimes met with as a congenital and habitual infirmity. It may affect more than one member of the same family. A most remarkable history of hereditary night-blindness, which has prevailed in one family for two centuries, has been recorded by the late M. Cunier.*

Persons thus affected, it has been remarked, are one half of them the offspring of parents related to each other. An instance of the kind has come under my notice. The parents were first cousins, and two of the sons were the subjects of night-blindness. They had, I believe, never seen the moon and stars. Both were very deaf.

I have met with a case of congenital central cataract combined with night-blindness. With the advance of life the visual field contracts, and the blindness may become so great that the persons find a difficulty in going about by themselves.

The ophthalmoscopic appearances in such cases are above described (p. 56).

A reference is there also made to a dissection of the eyes taken from the body of a young man who was deaf and dumb, and had been affected with night-blindness from childhood. The retina, especially on the outside, was found dotted all over with pigment deposits.

The defect of sight appears to depend on an atrophic state of the retina, manifested by pigmentation, shrunken blood-vessels, and partial opacities. Eventually the papilla optica is found atrophic and white, with degeneration of the choroid and vitreous.

The transition of simple night-blindness into amblyopia or amaurosis, may take place with symptoms of retinitis (*retinitis pigmentosa*), as in the following case:—

A coachman, about thirty years old, whose brother has been affected with night-blindness from birth, has himself been, for the last two months, incapable of seeing his way in driving when night came on. His health is good. His eyes look natural—pupils obedient to the light. The sight was so much improved under the use of alterative doses of mercury continued for three months, that he came to see pretty well at night. A spectrum, however, made its appearance before the right eye—at first in the form of a spot the size of a pea, dark by day, bright and starry looking by night: eventually, it appeared by day in the form of a flickering flame.

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* Annales de la Société de Médecine de Gand. 1840.

Along with this photopsy the sight became more impaired.

Prognosis and treatment.—In congenital night-blindness nothing is to be expected from treatment; but in cases, such as that just related, in which the symptoms of actual retinitis present themselves, it may be advisable to take blood by cupping or leeches, and to put the patient on a course of mercury or turpentine, or the two combined.

Day-blindness.

The photophobia, which persons accustomed to dark residences, albinoes, and children labouring under scrofulous ophthalmia, experience when exposed to strong daylight, does not merit the appellation of day-blindness, understood as the counterpart of night-blindness. In this sense it does not certainly appear that there is any such disease as day-blindness.

In amaurotic amblyopia, though the patient does not see well either by day or night, it happens in some cases that he sees proportionally better by night.

Fixed Muscæ.

These appearances never change their position, either in regard to each other or to the optic axis. Their motion is thus merely apparent, depending on the motion of the eyeball. But it often requires some attention and power of observation on the part of the patient to distinguish what is real from what is apparent motion.

Fixed muscæ vary in number, size, and form. At first semi-transparent, they afterwards become black, or at least dark. They appear in reading, like blotches on the paper, but when the eyes are directed to a distant object, they appear so large that they cover it perhaps. Fixed muscæ are most distinct in the light, in darkness they are either not seen or seen as luminous appearances. If confined to one eye they are most distinct when the other eye is closed.

Fixed muscæ are owing to insensible spots of the retina. The centre of the retina is sometimes the part affected, and the appearance seen is that of a dark spot in the middle of the field of vision. Thus the flame of a candle is, perhaps, invisible, whilst the light halo around is seen.

The appearance of a skin with veins in it, above referred to (p. 132), differs from the vascular spectrum as seen in Purkinje's experiment, inasmuch as it is owing to insensibility of the retina from the pressure and opacity occasioned by the congestion and exudation in inflammation of its vascular layer. It therefore belongs to the present head of fixed muscæ. Muscæ may change in form, size, and darkness; and though any given musca may not alter its position, it may disappear whilst others may present themselves in another part of the field.

The insensible spots of the retina on which the appearance of fixed muscæ depends, are the result of some form of posterior internal ophthalmia, and constitute partial amaurosis. This may pass into total amaurosis, the insensible spots gradually increasing in size until objects are no longer seen.

Ophthalmoscopic examination will disclose the particular morbid alteration of structure at the bottom of the eye on which the subjective symptom depends.

AMAUROSIS.*

Amaurosis is impairment or loss of sight from disease of the retina, optic nerve, or part of the brain with which the optic nerve is connected.

The *symptoms* of amaurosis are very various and inconstant.

As to the *causes*, they are morbid conditions of the optic nervous apparatus, differing both as regards nature and seat.

The *diagnosis* of amaurosis from cataract, mydriasis, short-sightedness, far-sightedness, asthenopia, muscæ volitantes, &c., requires to be formed in a great measure by the process *per exclusionem*. This being done, it remains to determine, as far as can be, the nature and seat of the affection of the optic nervous apparatus on which the defect of sight in the particular case depends.

For this purpose, we have recourse to ophthalmoscopic exploration.

Amaurosis must not be considered as a special disease, but merely a symptom of different affections of the optic nervous apparatus. Each particular case of amaurosis must, therefore, be specially studied in reference to diagnosis, prognosis, and treatment.

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* Gutta serena of the Arabians, in contradistinction to *gutta opaca*, the name they gave to cataract.

AMAUROSIS CONSIDERED EMPIRICALLY.

Different degrees of amaurosis.—Amaurosis is said to be *incomplete* or *complete*, according as the sensibility for visual impressions is impaired merely, or quite lost: and *partial* or *total*, according as the impairment or loss of sensibility affects a part only, or the whole retina.

In incomplete amaurosis, the patient's field of vision is obscured, as if a gauze or cloud were interposed between him and the objects looked at.

In partial amaurosis, the obscurity may involve the centre or the circumference of the field, or some one side only; or it may be limited to a mere spot, or to several spots dispersed throughout the field. Objects are thus seen or not, according to the part of the field of view in which they are situated; or if large enough to occupy the whole field, their circumferential or central part only is seen, or one half only (*visus dimidiatus*), or a part here and there (*visus interruptus*). When the insensibility is limited to a spot or spots merely, the appearance of *fixed muscæ* is occasioned. (See above, pp. 72, 73, 533).

Peculiarities of amaurotic vision.—Vision is often better one day, worse another; sometimes better in the morning, sometimes in the evening; sometimes better after meals, sometimes worse.

The amaurotic person generally sees an object indistinctly, until such time as he has steadily fixed his eyes on it (*visus increscens*). Sometimes, however, by moving the object before him, he sees it better than when at rest.

Objects sometimes appear askew, sometimes smaller (*amaurotic micropy*), (p. 527).

The patient usually sees better in strong light, but in some cases, better in dull light. Sometimes he is intolerant of light, even when the amaurosis is complete.

In some cases the patient sees distant objects better than near; in other cases again, near objects better than distant; and sometimes he sees objects multiplied with one eye, and iridescent: the flame of a candle, for instance, spreading out into rays, and surrounded by coloured haloes; but such symptoms are owing rather to defective adjustment than to defective sensibility.

Subjective visual sensations.—Photopsy, chroopsy, and the undue retention of impressions, giving rise to ocular spectra and accidental colours, are frequent attendants on amaurosis. The gauze or network seen in the light may still be visible in the dark; but instead of being gray or black, it is of a silvery or gold colour.

Common subjective sensations.—Uneasy feelings or actual pain in the eye or head, may or may not have been, or be present. Dryness of the eyes and nostrils is sometimes felt.

Objective symptoms.—The defective and disturbed vision may be the only symptom present. There may be no objective symptom, even the staring appearance of the eyes, and their want of power to converge on an object with precision, may be absent. In general, however, there are objective symptoms enough to indicate the nature of the affection, and to confirm the patient's statements.*

The pupil is more or less dilated, and if not quite immovable, its movements are limited and slow. This, although one of the most characteristic appearances presented by the amaurotic eye, is not constant. In cases in which one eye only is affected, the pupil often moves quite naturally, consentaneously with the pupil of the healthy eye; but if this latter eye be covered, whilst the amaurotic eye is examined under the influence of different degrees of light, then the pupil of the amaurotic eye is found to remain dilated and fixed, uninfluenced by the degree of light. Sometimes again, in complete amaurosis of both eyes, the pupils are as obedient to changes in the degree of light as in health (p. 448).

Besides the peculiarities of the pupil just considered, there may be deformity of it from greater dilatation towards some one or other side, or even a displacement of the pupil, and the iris may be inclined towards the cornea, or its pupillary margin reverted backwards from the cornea.

Sometimes the pupil is much contracted (p. 449).

There is often an appearance as if of opacity behind the pupil, deep-seated, analogous to the appearance in glaucoma, but pale, and not so well marked. It is to be remarked, however, that this appearance in an equal degree, may sometimes be seen in elderly persons, whose vision is quite good; and on the other hand, numerous cases of amaurosis, and this of the most complete kind, especially in young persons, present no such appearance of opacity, but a clear black pupil.

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* The general aspect of the amaurotic patient is above sketched (p. 2).

In uncomplicated amaurosis, the catoptrical lenticular images are distinct.

Congestion of the conjunctiva, or, on the contrary, great paleness of it, lacrymation or dryness of the eyes, too great hardness, or too great softness of the eyeball, increased prominence, strabismus or paralytic luscitas, and rolling of the eyes, may, in different cases, be accompaniments of amaurosis.

General symptoms.—Symptoms of intracranial disease often attend amaurosis, such as pain in the head, constant, intermittent, or periodic, and varying in seat, extent and nature; vertigo, tinnitus aurium, tendency to coma, sleeplessness, &c.

The digestive organs are sometimes deranged, sometimes not.

The pulse may be strong, or weak, or natural.

Such are the principal symptoms which may attend amaurosis. Some, it will be observed, are altogether the contrary of others, so that not one alone can be admitted as pathognomonic, scarcely even the defective vision itself.

These differences in the phenomena depend partly on differences in the nature of the morbid condition on which the loss of sensibility depends, partly on the degree of development of that morbid condition. For the same reason the invasion and progress of the disease differ in different cases.

Invasion and progress.—The invasion of the amaurosis may be sudden or gradual. In the former case, vision may be at once wholly lost, or nearly so; in the latter case, it may be only after a time that the vision is seriously impaired. In some cases, the impairment of vision remains at a certain stage without advancing, in other cases it continues to increase, the obscurity thickening and spreading, until the whole field of vision is obliterated to the sense, the perception of light lost, and the amaurosis complete. Sometimes amaurosis commences as night-blindness.

Except when the cause is of a purely local nature, both eyes generally become affected; one eye first perhaps, and by-and-by the other. The blindness being complete and total in one eye, some degree of vision may be still retained in the other.

Constitution, and previous diseases of the patient.—Amaurotic patients are met with of all constitutions, and are found to have been the subjects of very different diseases, and yet these diseases will often appear to have had some connection, either as cause, or as themselves depending on the same cause with the amaurosis, and may still require to be taken into consideration along with the present state of general health of the patient, in determining the kind of treatment to be had recourse to.

The diseases the existence of which is often found to have some connection with the amaurosis, either as cause, or as depending themselves on the same cause, are, scrofula, syphilis, gout, rheumatism, dyspepsia, albuminuria, diabetes, oxaluria, hypochondriasis, hysteria, apoplexy, epilepsy, paralysis, phrenitis, typhus fever, lead poisoning, anemia, worms, &c.

In some cases the disease is found to occur in connection with disturbed menstruation, hysteria, pregnancy, during labour, hæmorrhoids, and again to disappear entirely, but again to occur, and then perhaps to remain permanently.

Causes.—The paralysis of the optic nervous apparatus, on which amaurosis depends, may be the result of morbid conditions of that apparatus, differing both as regards nature and seat.

As regards nature, they may be congestion or inflammation, and its consequences; nervous exhaustion; or pressure by neighbouring parts. As regards seat, this may be in the retina, or the optic nerve, or the cerebral portion of the optic nervous apparatus. Sometimes it is a simple extravasation of blood in front of the retina and in the vitreous humour which may be the cause of a sudden amaurosis.

Diagnosis in general.—Amaurosis, in its incipient stage especially, ought to be carefully distinguished, for this is in general the only stage at which treatment is likely to be of much avail.

The affections from which amaurosis requires to be distinguished are principally:—cataract, mydriasis, myopy, presbyopy, asthenopy, muscæ volitantes, night-blindness, glaucoma. See those different articles.

Amaurosis is, however, often complicated with some one or other of these affections.

The distinction of incipient amaurosis from incipient cataract, is of especial importance, as supposing incipient amaurosis mistaken for incipient cataract, it might be allowed to go on unchecked, under the impression that ripening of the cataract was taking place. The patient would thus be deprived of all chance of the benefit which might be derived from treatment in rescuing him from irretrievable blindness.

Prognosis.—The prognosis in a decided case of amaurosis is most unfavourable. The disease, when it comes on suddenly, even when complete blindness is present, is not unfrequently relieved or cured, if it has not already existed long. The disease which has come on gradually, accompanied by pains in the head, is more hopeless in general, as in this case the cause most usually is material disorganization of some part of the optic nervous apparatus; whereas, sudden cases may be owing to some congestion, extravasation, or exudation, admitting of removal by timely treatment.

The prognosis is decidedly bad when the eyeball is either preternaturally hard or soft, or affected with cataract; or if the disease is hereditary, or complicated with epilepsy, paralysis of some part indicating affection of the brain, &c.

In cases in which one eye only is affected, there is reason to fear for the other.

AMAUROSIS CONSIDERED PATHOLOGICALLY.

Seat of the morbid conditions of which paralysis of the optic nervous apparatus may be the result.—The retina, the optic nerve, or that part of the brain with which the optic nerve is connected, may be together or separately the seat of the morbid condition on which the amaurosis depends. If the retina only be affected, it cannot receive the impression which should be transmitted by the optic nerve to the brain;—if the optic nerve only be affected, it cannot transmit the visual impression from the retina to the brain;—if that part of the brain with which the optic nerve is connected be alone affected, the sensorial power to take cognizance of the visual impressions transmitted by the optic nerve is lost.

Thus, the general result is the same, whether the different parts of the optic nervous apparatus be affected together or separately. Notwithstanding this, it is o importance practically to determine as accurately as possible the seat of the morbid condition, on which the los of vision in any given case depends.

Nature of the morbid conditions of which paralysis of th optic nervous apparatus may be the result.—In the fir place, it is to be observed, that paralysis of the opti nervous apparatus, like paralysis of other parts of the nervous system, may occur without any morbid condition the nature of which is appreciable, either by particular symptoms during life, by ophthalmoscopical exploration or by anatomical examination after death. Generally however, there are symptoms and ophthalmoscopical appearances sufficient to account for the paralysis. In regard to appearances after death, it is to be observed that many of the morbid conditions in which the optic nervous apparatus has been found, in cases of amaurosis, though of themselves very efficient causes of paralysis, and irremediable, are not to be viewed as standing in the relation of original cause of the amaurosis, but rather as the effect, or, at the least, as the coincident effect of the morbid condition which was the immediate cause of the paralysis. To such morbid conditions may be referred, hardening or softening of the brain, of the optic nerve or retina, atrophy, thickening or other enlargement (which may be followed by atrophy).

The morbid conditions, acting as the immediate cause of paralysis of the optic nervous apparatus in amaurosis are in their nature essentially the same as those which act as the immediate cause of paralysis of other parts of the nervous system, and may be referred to the two principal heads of intrinsic and extrinsic.

Intrinsic morbid conditions of the optic nervous apparatus acting as causes of its paralysis in amaurosis.—These may be at first inflammation or simple congestion of some part or the whole optic nervous apparatus, and as effects of this, exudation of serum or lymph, or extravasation of blood. Or the opposite condition of a defective supply of blood to the parts followed by marasmus.

These morbid conditions, it is to be observed, may not be confined to the optic nervous apparatus, but extend to the brain generally, in which case the amaurosis will form a point of inferior consideration.

Morbid conditions extrinsic of the optic nervous apparatus acting as causes of its paralysis in amaurosis.—These opeate by *pressure* on the optic nervous apparatus. To them elong abscesses of the brain, hydrocephalic collections one of the most remarkable of the hydrocephalic amau-oses is that consequent to scarlatina), tumours, &c., of he brain or its membranes, aneurismal affections of the erebral or ophthalmic arteries, exostosis, &c., of the ones of the cranium or orbit, abscesses in the orbit, umours in the orbit, or in the neighbouring cavities and inuses of the skull or face, affections within the eyeball, s inflammation of the choroid, hydrophthalmic collec-ions, and the like.

Eventually the pressure may produce organic change f the optic nervous apparatus.

It will be observed that many of these morbid con-litions are of such grave importance in themselves, that he amaurosis produced by them forms but a secondary onsideration in the case.

Both intrinsic and extrinsic morbid conditions of pa-alysis in amaurosis may co-exist. Examples readily uggest themselves. To take one from the eyeball, esides inflammatory or simple congestion of the retina, here may be a similar state of the choroid producing ressure on the retina.

Amaurosis from intraocular disease.

Morbid conditions of the retina on which the paralysis in maurosis may depend.—Intrinsic.—Vascular congestion f the retina or choroid, or both, simple or inflammatory, cute or chronic, and, as the consequence of it, effusion f serum or lymph; extravasation of blood, degeneration f the structure of the retina (see *Posterior Internal Oph-halmia*, and Plates VI. and VII. representing the oph-halmoscopic appearance in choroiditis and retinitis), hickening, atrophy, softening, adhesion between the etina and choroid, &c.[*] Injuries, whether direct wounds,

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[*] The name cat's-eye has been applied to cases of amaurosis in hich there is a reflection from the bottom of the eye, similar to hat in the cat; but the appearance is by no means characteristic f any one disease of the eye.

Beer, who introduced the term, and who describes cat's-eye as he type of his second class of forms of amaurosis, viz., that haracterized not only by subjective, but also by objective symp-oms, mentions having met with it most frequently in old persons or the lesion, produced by concussion, such as laceration (p. 59), or by a sudden glare of intense light, or by over-exertion of vision.

Extrinsic, but still seated within the eyeball.—Pressure on and disorganization of, the retina, occasioned by inflammation or congestion of the choroid and its consequences. Subsclerotic dropsy, detachment of the retina from the choroid, vitreous dropsy, hæmophthalmus, &c.

The ophthalmoscopical appearances in intraocular disease have been described in their proper places (pp. 52, et seq., 124, et seq.).

Amaurosis from extraocular disease.

The morbid conditions seated outside the eyeball, are, for the most part, the same as the extrinsic morbid conditions to which the orbital portion of the optic nerve is subjected.

Morbid conditions of the optic nerve on which the paralysis in amaurosis may depend.—Intrinsic.—Direct injury of the optic nerve.—Congestion, simple or inflammatory, and its effects, general or partial induration or atrophy,—thickening of the sheath and exudation between it and the nerve. Tumours attached to or contained within the sheath or involving the substance of the optic nerve, including medullary or melanotic disease. Aneurismal enlargement of the central artery of the retina while within the optic nerve. Extravasation of blood in the same place. Embolism of the central artery.

Extrinsic.—These necessarily come under two separate heads, viz., those to which the orbital, and those to which the intracranial portion of the optic nerve is subjected.

The latter will come under the more general head of extrinsic morbid conditions affecting the intracranial portion of the optic nervous apparatus; the former therefore alone fall to be enumerated here.

inclined to marasmus, but sometimes in young persons, especially cachectic adults and atrophic children; he had also seen it after injuries of the eye.

The reflection from the bottom of the eye, occurring after injuries, has been above explained (p. 322, et seq.), and appears to be quite different from the condition, whatever it may be, which gives rise to the appearance in old persons.

Inflammation and abscess in the orbit; exostosis of the orbital bones; tumours in the orbit or neighbouring cavities; (among which may be placed abscess in the antrum from carious teeth;) fractures of the anterior part of the base of the skull or of the orbit.

Amaurosis from intraspinal or intracranial disease.—Spinal or cerebral amaurosis.

Morbid conditions of the intracranial portion of the optic nervous apparatus on which the paralysis in amaurosis may depend.—*Intrinsic.*—Injuries—concussion, laceration; congestion—simple or inflammatory, and its effects, hardening or softening, hypertrophy or atrophy, abscess, &c.; apoplexy; scrofulous tubercles; tumours of different kinds; hydatids.

These morbid conditions may implicate other parts of the spinal marrow or brain at the same time.

Extrinsic.—Fracture of the cranium with depression or extravasation of blood in the situation of the intracranial portion of the optic nervous apparatus; exostosis of the bones of the cranium in the same situation; tumours of the dura mater; inflammation of the membranes of the brain, and its consequences, adhesions, thickenings, de-

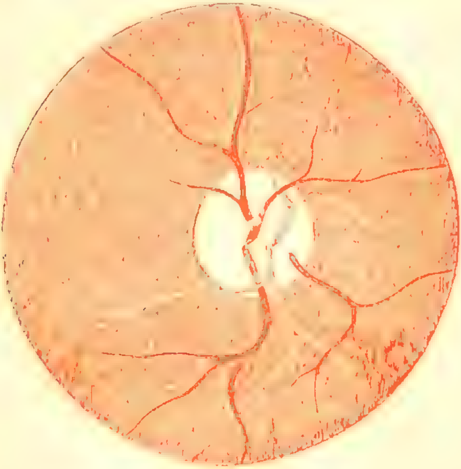

FIG. 135.

positions of serum, lymph, pus, &c.; hydrocephalus, superficial or ventricular; tumours of the brain, implicating the optic nervous apparatus by pressure, such as enlarged pituitary, or pineal gland; aneurism of one of the encephalic arteries.

Of these different morbid conditions, it is to be observed, that many of them are well marked and recognized forms of disease in the rational pathological sense, the amaurosis being at once recognizable as a symptom merely. Others, again, are not so recognizable during life, and the blindness being the prominent symptom, the case is said to be one of amaurosis in the empirical sense.

The ophthalmoscopical appearance in amaurosis from extraocular or intracranial disease is inflammatory swelling, ending in white atrophy of the optic papilla (pp. 53, 128), and shrunk state of the retinal vessels. (Fig. 135.)

Causes of the different morbid conditions of the optic nervous apparatus in amaurosis.—These may be said to comprehend the remote causes of disease in general, in addition to such as act on the eyes in particular.

Amaurosis in its connection with certain general complaints.

Amaurosis in cases of lead poisoning.—This in general presents the characters of cerebral amaurosis, and its prognosis is of a very unfavourable character.

Amaurosis in cases of over use of tobacco.—The over use of tobacco has been much insisted on by Dr. Mackenzie as a cause of amaurosis. It has been shown by Mr. Jonathan Hutchinson that a special form of cerebral amaurosis, with white atrophy of the optic papillæ, is more common in men than women, and that a large proportion of those who suffer from it have been smokers.

Persons affected at an earlier age than usual with glaucomatous amaurosis, or that state of the eyes in which inflammation, from any occasional cause, is apt to assume the gouty character and rapidly destroy sight, I have found to have been long addicted to an excessive use of tobacco, and sometimes spirit-drinking.

Amaurosis in cases of albuminuria.—In 280 cases of albuminuria, M. Lacorché met with dimness of sight in sixty-two. The amblyopia is attended by dilatation of the pupil, puffiness of the eyelids, prominence of the globes from serous effusion in the orbit, with other œdematous or dropsical manifestations elsewhere.

The ophthalmoscopical appearances in amaurosis from albuminuria are above described at pp. 55, 56, and 128, and represented by the figure here reproduced.

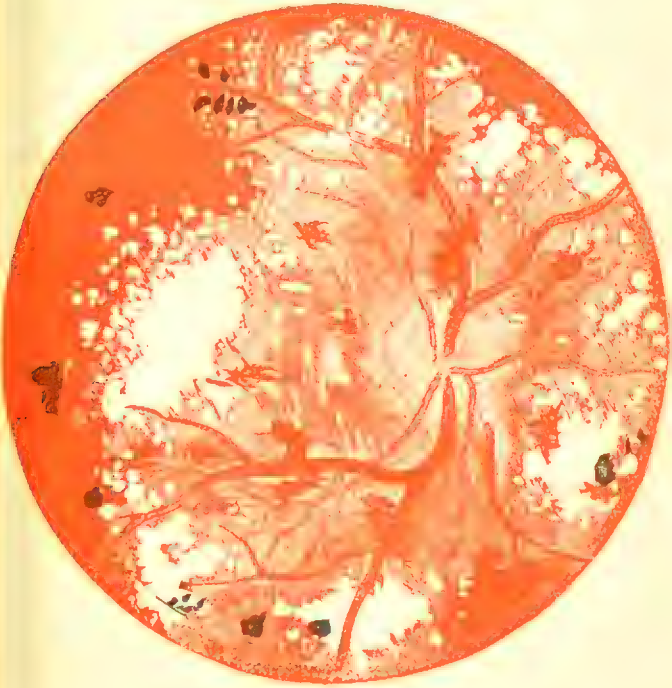

Fig. 136.

Amaurosis in cases of diabetes.—In diabetes, amblyopia sometimes occurs; often along with cataract. See above, pp. 338, 339.

Amaurosis in cases of oxaluria.—Dr. Mackenzie has recently recorded a case of amaurosis coincident with oxaluria, in which great benefit was derived from ten minims, thrice daily, of a mixture of equal parts of nitric and muriatic acids.

Dr. Mackenzie conjectures that the affection of the sight was the result of poisoning of the blood with oxalic acid; as in albuminuria it appears to be the result of poisoning of the blood with urea, and, it may be added, as in diabetes, perhaps, from poisoning with sugar.

Amaurosis in cases of disease of the heart.—The immediate cause of the loss of sight in such cases is often apoplexy of the retina. See above, p. 310.

In disease of the valves of the heart, fibrinous floccules are deposited in the blood, and carried along by the circulation. If such a floccule should be arrested in the central artery of the retina, an impediment to the circulation of the blood in that membrane would be occasioned.

From the microscopical observations which I have made on embolism,* it appears that the first effect of an *embolon* of fibrin in a small artery is congestion, by regurgitation, of the capillaries and venous radicles of the part to which the artery leads; the vessels and surrounding structures being healthy.

The phenomena of embolism as commonly described—viz., collapse and emptying of the vessels—indicate an already morbid condition of the vessels and surrounding structures, as well as a morbid condition of the blood.

Amaurosis from the sudden suppression of habitual discharges.—The sudden suppression of habitual discharges operates generally by determining internal congestion or hæmophthalmus.

Amaurosis from syphilis.—Syphilitic amaurosis chiefly belongs to the head of syphilitic posterior internal ophthalmia. Cerebral amaurosis occasionally has its origin in some intracranial syphilitic affection.

Congenital amaurosis.—It sometimes happens that an infant, though old enough to notice, does not follow a lighted candle or other bright object with its eyes. This is sufficient to raise a suspicion of amaurosis.

This suspicion will probably prove too well founded if the eyeballs are at the same time smaller or larger than natural, or if they have a rolling motion in the sockets.

If, however, the eyes are otherwise healthy-looking, and especially if the pupils contract naturally under the influence of the light, the child may, in the course of some months, come to give more and more evident signs of gaining strength of vision, which by the end of the first year may appear perfect.

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* See my Essay "On the State of the Blood and Bloodvessels in Inflammation," in Guy's Hospital Reports for October, 1850; and my Paper "On the Discovery of the Rhythmical Contractility of the Veins of the Bat's Wing," in the Philosophical Transactions for 1852.

When the eyes are smaller than natural, there is not much hope of sight being acquired.

Dropsical enlargement of the eyes sometimes exists at birth. The cornea in such cases, besides being unusually large, is opaque or cloudy. There appears to be at the same time defective sensibility of the retina. In a few instances the cornea has, with the growth of the child, become clear, and some degree of vision been acquired (pp. 297, et seq.).

Congenital amaurosis may be owing to imperfect development, or to disease already affecting the eyes before birth, or to injury of the head of the child in instrumental delivery.

Under the ophthalmoscope I have sometimes seen white atrophy of the optic papilla.

Congenital amaurosis may be complicated with cataract.

Loss of sight in infants from congenital syphilitic posterior internal ophthalmia, has been above noticed, p. 241.

AMAUROSIS CONSIDERED THERAPEUTICALLY.

The nature of the morbid condition on which the amaurosis depends, and the causes which may have excited that morbid condition, are points which must be ascertained before any rational mode of treatment can be determined on. In numerous cases, however, it must be confessed that these points cannot be satisfactorily determined; the treatment adopted must therefore be partly empirical and partly founded on general indications.

The different morbid conditions on which amaurosis may originally and essentially depend are, it has been above seen, referable to the three following principal heads:—

1. Congestion or inflammation, implicating some part of the optic nervous apparatus, and its effects.
2. Exhaustion of the optic nervous apparatus.
3. Pressure on some part of the optic nervous apparatus.

These conditions, however, it is to be observed, may be more or less mixed up with each other, or one may supervene on the other; hence, according as one or other appears to be in operation at the time, so must be the treatment.

Amaurosis from congestion or inflammation implicating some part of the optic nervous apparatus.

The causes to which congestive amaurosis is owing are very various. Exposure of the eyes to strong heat and light in those who work before large fires, &c., or to the glare of light upon the sea. Over-exertion of the sight. Forced exertions of the body while stooping the head, especially in plethoric or drunken persons. Pregnancy. Sudden suppression of discharges—the menstrual, perspiratory, hæmorrhoidal, purulent, &c. Gastro-hepatic or gastro-intestinal irritation, as in dyspepsia, costiveness, worms. Irritation of the nerve of the fifth pair. Passions of the mind. Fevers. Spirit drinking. Excessive use of tobacco, &c.

Prognosis and treatment.—The cases of amaurosis under consideration, if early seen, are in general those in which treatment may be undertaken with most hope of advantage, provided—and this is the first point to which attention must be directed—the causes just enumerated can be avoided, removed, or mitigated.

The plan of treatment is, first, the general antiphlogistic plan above described (pp. 138, et seq.), consisting principally of bleeding and mercurialisation, and afterwards the tonic and alterative, together with counter-irritation (p. 147).

If the disease has already fallen into a chronic state, the tonic and alterative plan of treatment, with counter-irritation, may be the only one admissible.

The amauroses which arise from super-excitation occasioned by sudden strong impressions on the retina, such as an intense glare of light falling on the eye, concussion of the eyeball, or a stroke of lightning, and also those arising from overplying vision, appear to depend partly on nervous exhaustion, and partly on congestion. For example, the spot of the retina acted on by a sudden glare of light, or by smart concussion from a blow, is at once rendered insensible, and the result is a fixed musca, which may ultimately go away or remain; or the whole retina may become insensible, though this more generally takes place slowly, as a consequence of supervening congestion or inflammation.

In such a case the treatment should be the same as for congestive amaurosis.

Amaurosis from exhaustion of the optic nervous apparatus.

Exhaustion of the optic nervous apparatus is often a mere accompaniment of general nervous exhaustion, arising from great loss of blood, or excessive discharge of secretions, as in protracted suckling, venereal excesses, or arising from grief and other depressing passions—from low nervous fevers, fright, &c.

Prognosis and treatment.—In the cases depending on exhaustion of the nervous system, the prognosis is much less favourable than in those depending on congestion.

The plan of treatment fitted for them is the tonic or tonic and alterative (p. 147), in prolonged courses.

It is in this form of amaurosis that strychnia and veratria, endermically applied, have been much recommended; but their efficacy has not been satisfactorily established. The same must be said of electricity and galvanism, and stimulating vapours to the eyes.

Amaurosis resulting from pressure on some part of the optic nervous apparatus.

In many such cases the amaurosis is but a secondary consideration, more pressing symptoms of the organic disease being present; in other cases the amaurosis may be the only or principal appreciable symptom.

Prognosis and treatment.—Except when the cause of pressure is seated in the orbit or in the eye, and is removable by operation, any treatment adopted must be regulated according as the general symptoms agree with one or other of the preceding forms, consisting, in the one case, of blood-letting and mercurialisation; in the other, of tonics, alteratives, and counter-irritation. When, as is often the case, it cannot be determined what is the nature of the cause of pressure, or even that the case is one of pressure, the treatment must still be regulated by the same principles.

SECTION III.—GLAUCOMA.

Glaucoma is a name applied to a peculiar greenish opaque appearance, deep behind the pupil, changing its seat according to the direction in which the light is admitted, being always most concentrated on the side opposite the light. This appearance occurs in very different degrees, from a greenish-grey reflection barely discernible, to a grass-green opacity.

Hippocrates and the ancient Greeks comprehended under the name of *glaucoma* every kind of opacity which appears behind the pupil. The later Greeks—as Rufus, Galen, Paul of Egina, and others—however, restricted the term to incurable opacities behind the pupil, while to the curable they gave the name of *hypochyma*:—the former they supposed to be a disease of the lens, the latter to be a concretion in front of the lens.

Brisseau* appears to have been the first who gave out the opinion, that while cataract, as first shown by Rolfink, Borel, and others, is an opacity of the crystalline body, glaucoma is an opacity of the vitreous.

By some the appearance of glaucoma has been supposed to be owing to reflexion from the bottom of the eye, in consequence of the morbid state of the retina and choroid, with loss of pigment, which often exists in glaucoma.

It was, however, satisfactorily demonstrated by Dr. Mackenzie, in 1828, that the cause of the glaucomatous appearance resides in the lens.

The change in the state of the lens, on which the glaucomatous appearance depends, consists in its having become, especially in its central part or nucleus, of a more or less deep amber colour when viewed by transmitted light,—green when viewed by reflected light. The lens usually retains its transparency unimpaired, except in so far as the depth of colour interferes with it, but it may become at the same time more or less opaque.

The proofs adduced by Dr. Mackenzie that the cause of the glaucomatous appearance resides in the lens, are the following:—

---

* Traité de la Cataracte et du Glaucome. Paris, 1709.

1. On removing the lens by operation from a glaucomatous eye, the pupil no longer presented the sea-greenish colour, but appeared black, as natural.
2. On dissection of glaucomatous eyes, he found the lens, especially its central part or nucleus, of a yellow, amber, yellowish-red, or reddish-brown colour, when viewed by transmitted light; greenish when viewed by reflected light.

In demonstration of the different degrees of opacity of the lens which may exist in the different stages of glaucoma, Dr. Mackenzie was the first to apply the catoptrical test (p. 33).

Along with a glaucomatous appearance behind the pupil, vision may still be good, or it may be defective or totally lost. In the latter case, the defective vision may be owing in part to the deeply-coloured nucleus of the lens intercepting the rays of light in the manner of cataract, or to actual cataractous opacity co-existing, but in most cases it is owing to complication with insensibility of the retina.

From this it may be inferred, that the glaucomatous appearance of the lens occurs in diseased states of the eye, essentially different from one another. Hence, if we take glaucoma as a genus, the principal species are as follow:—

1. *Simple glaucoma.*
2. *Glaucoma with cataract.*
3. *Chronic glaucoma with amaurosis.*
4. *Acute glaucoma with amaurosis.*
5. *Chronic glaucoma with amaurosis and cataract.*

1st.—*Simple glaucoma.*

Here we have the glaucomatous appearance behind the pupil, but the eye, in other respects, appears quite healthy—the cornea clear, the pupil lively, the consistence of the eyeball normal, and vision—with the exception that it may be presbyopic or myopic—good.

Simple glaucoma is of frequent occurrence in old people. It continues for life, but does not necessarily become complicated either with cataract or amaurosis.

2nd.—*Simple glaucoma with cataract.**

In this species of glaucoma, the green reflexion from the glaucomatous nucleus of the lens, is seen somewhat obscured by the cataractous whiteness of the surface. The retina is sound, but, as is usual at the advanced period of life when this species of cataract occurs, the vitreous body may be more or less dissolved.

This form of glaucoma does not essentially differ from the kind of hard cataract above noticed (p. 340).

Treatment.—As was first pointed out by Dr. Mackenzie in 1828, the operation for cataract may be performed with success in cases of simple glaucoma with cataract. But this is the only species of glaucoma in which an operation for the removal of the lens is admissible.

3rd.—*Chronic glaucoma with amaurosis.*

This, which is the species of glaucoma generally taken as the type of the disease, is identical with chronic arthritic posterior internal ophthalmia (pp. 241, et seq.).

The eyeball is hard to the touch from dissolution of the hyaloid, and superabundance of vitreous humour. The sclerotica is attenuated and dark-looking; the white of the eye pervaded by varicose vessels; the cornea often slightly nebulous and rough; the iris pale and inclined towards the cornea; the pupil, at first limited and sluggish in its motions, becomes dilated—generally ovally dilated—and fixed; the peculiar glaucomatous appearance behind the pupil well marked.

Vision is impaired or lost.

In addition to the defective vision, there are muscæ and fiery and coloured spectra before the eyes, and not unfrequently more or less severe pain in the forehead, supra-orbital regions, temples or face, of a rheumatic or gouty character.

Both eyes are usually affected, but one may be less so than the other.

The characters above given (p. 345), as distinguishing glaucoma from cataract, are those of this form of glaucoma.

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* Simple glaucomatous cataract—green cataract in the limited acceptation.

4th.—*Acute glaucoma with amaurosis.*

This is identical with acute arthritic posterior internal ophthalmia above described (pp. 241, et seq.).

5th.—*Chronic glaucoma with amaurosis and cataract.*

This is an advanced stage of glaucoma. The eye is now quite insensible to light, but photopsia and pains around the orbit may continue.

The pupillary margin of the iris is perhaps retroverted, and the lens, now become cataractous, protrudes through the dilated pupil into the anterior chamber, and even comes to press on the cornea. The cornea may, in consequence, be destroyed by ulceration, and the lens evacuated with hæmorrhage.

6th.—*Nature of glaucoma with amaurosis, and its treatment by iridectomy.*

The mode of performing iridectomy as a means of treatment in glaucoma, &c., has been above described, pp. 151, et seq. Here we have to inquire into the merits of the operation.

Though giving the name to the disease, the sea-green opaque appearance behind the pupil in glaucoma, it is to be remembered, is merely an incidental accompaniment of it. A very much more serious state of matters characterises its real pathology. Indeed, the appearance of a greyish or greenish opacity behind the pupil is, as above mentioned, not at all an uncommon appearance in the eyes of old persons whose sight, considering their age, is not particularly impaired.

Great venous congestion may be said to be the characteristic morbid condition of the eye in glaucoma; and the parts, the congestion of which is more immediately fatal to the sight, are the choroid and retina.

If we examine the interior of a glaucomatous eye by means of the ophthalmoscope, we not unfrequently find that the humours are sufficiently clear to allow of the state of the *papilla optica*, retina, and choroid being ascertained.

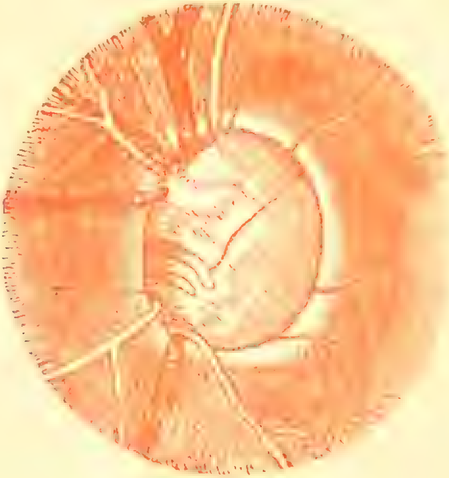

FIG. 137.

In this figure (137), from Liebreich's Atlas, the limit between the retina and papilla is seen strongly marked, and the sclerotica where it joins the sheath of the optic nerve shining through as a prominent yellowish-white ring or border, so that there appears an excavation of the optic nerve at its entrance (Fig. 138). In the middle it is

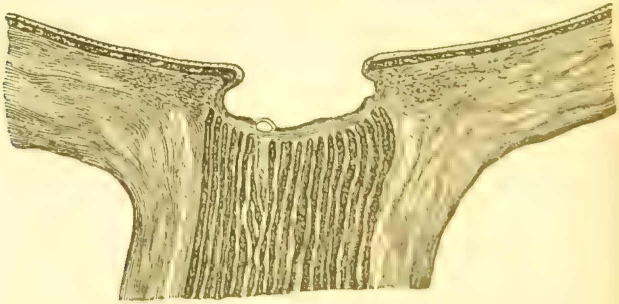

FIG. 138.

clearer, and the *lamina cribrosa* very distinct, the more so the deeper the excavation.

In consequence of the excavation of the papilla optica, the course of the retinal vessels on entering the eye appears peculiar. Having penetrated the lamina cribrosa, they run on the bottom of the excavation, by the overhanging margin of which their further course is concealed; and when they reappear on the retina, they do not look like continuations of the same vessels.

The arteries of the retina being constricted, appear slender and pale, whilst the veins are dark and enormously distended.

As to the alterations observed in the condition of the choroid: The quantity of the pigment in the cells of the pigment membrane is diminished, whilst there may be an increase in the quantity of the pigment in the cells of the stroma of the choroid. In this case, the vessels of the choroid—the larger vessels of the choroid—are seen in ophthalmoscopical examinations more distinctly, and with dark spaces between them.

The turgid tortuous ramifications of the veins on the white of the eye, extending from the place of insertion of the recti muscles, manifest a state of external venous congestion likewise. Indeed, the glaucomatous condition of the eye very generally coexists with abdominal congestion and hæmorrhoidal disease—so much so, that the turgid and tortuous veins so common in the white of the eye in such cases have been named "abdominal vessels."

In the glaucomatous eye, even at a very early stage of the disease, the iris is inclined towards the cornea, and the aqueous chambers are diminished in depth. This is owing to the increased accumulation of blood in the veins of the choroid and retina, and to an increase of the fluid in the cells of the vitreous body—itself the result of the congestion—whereby the posterior segment of the eyeball is distended and the lens pressed forward against the iris.

It is partly owing to this posterior intraocular distension that the papilla optica becomes excavated, and that the retina suffers.

It is in consequence of this posterior intraocular distension also that the eyeball is felt so hard to the touch.

Owing also to the intraocular distension, pain in the eye, around the orbit, and all over the side of the head, is a very common attendant of glaucoma. It is especially severe when inflammation of the eye supervenes, which it is very prone to do. In this case also the sight is rapidly destroyed.

The inflammation is of that character which has been named arthritic posterior internal ophthalmia. The affection is also named acute glaucoma.

I have said that the lens, though it looks opaque in glaucoma, may be still clear enough to permit the bottom of the eye being ophthalmoscopically examined. The lens, however, is liable eventually to become cataractous. In such cases, there is usually already disorganization of the retina, so that the cataract is merely superadded to hopeless amaurosis.

On subjecting the retina of a glaucomatous eye to microscopical examination, I have found the radicles of the veins with varicose dilatations, or pouches like what is represented in this figure:—

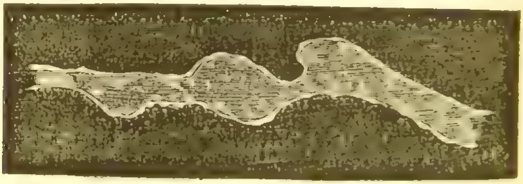

FIG. 139.

The capillaries have been said to be varicose, but I did not find them so, and I do not remember, in the course of all my researches into the state of the bloodvessels in inflammation, to have found anything which could be called a varicose condition of the capillaries. Constricted arteries appear, with their walls much thickened from contraction of their circular muscular fibres. This thickening of the walls of the arteries must not, however, be called hypertrophy. In the web of the bat's wing or frog's foot under the microscope, thickening of the walls of the artery is seen to take place when the calibre of the vessel becomes constricted by contraction of the circular muscular fibres; and, on the other hand, it is seen to be superseded by thinning, when the calibre of the artery becomes widened by relaxation of the circular muscular fibres.

The varicose state of the venous radicle represented in figure 139, I saw take place in the mesentery of the living mouse, under the microscope, by the walls of the vessel here and there becoming much constricted, and here and there much dilated. This was towards the end of the observation. The corresponding arteries were constricted, except where their last ramifications opened into the capillaries. Here the flow of blood in them was retrograde and sluggish. In the varicose venous radicles there was congestion of red corpuscles.

The observation to which I refer, illustrates the relation between constriction of the arteries and congestion of the veins, as above explained, pp. 103, et seq.

Seeing that constriction of the small arteries of a part causes congestion of the capillaries and venous radicles to which they lead, and seeing that the fundamental morbid condition of the eye in glaucoma is great venous congestion, with constriction of the small arteries, we can understand how it is that belladonna or atropia applied to the eye in glaucoma, aggravates the symptoms.

The venous congestion of the choroid and retina in glaucoma, as we have seen, causes some degree of intraocular distension. And as an effect of the continuance of this congestion, there supervenes an increase of the fluid of the cells of the vitreous body, which occasions a corresponding increase of the intraocular distension.

Whilst in anterior internal inflammations of the eyeball, in which evacuation of the aqueous humour is often so beneficial, the intraocular distension has its seat especially in the anterior segment, as may be seen by the prominence of the cornea and depth of the aqueous chambers,—here the intraocular distension has its seat chiefly in the posterior segment.

One effect of the distension in the posterior segment of the eyeball, is seen to be that the lens and iris are pressed forward, and the aqueous chambers thus diminished in depth. Another effect of the intraocular distension implicating the posterior segment, appears to be the excavation of the *papilla optica*, as seen with the ophthalmoscope, an effect the possibility of which may be conceived if we call to mind that the optic nerve, enclosed in its neurilemma, lies within its fibrous dura-matral sheath (which is continuous with the sclerotica) to a certain extent free, like a viscus in a serous cavity; for such a connection could allow of the nerve being slid slightly back into the sheath by the long-continued intraocular pressure bearing on the lamina cribrosa. Some degree of atrophy of the optic nerve appears also to have a share in the production of the excavation at its entrance. Perhaps also, on the other hand, an elevation of the retina, in the manner of chemosis, by the congested and thickened choroid.

In the earlier stages of glaucoma, the sight varies, being sometimes better and sometimes worse. The improvement of sight occurs in fine weather, after rest of the eyes, and when the digestion is good, and bowels free. These and other similarly favourable conditions, we can understand, promote diminution of the intraocular congestion, and thus determine a corresponding relief of the pressure on the retina. The deterioration of sight, on the contrary, occurs under the influence of opposite conditions, and especially mental depression, whereby the intraocular congestion is increased, and the pressure on the retina correspondingly aggravated.

In a more advanced stage, when the retina has suffered in its integrity, any occasional diminution of the intraocular congestion affords but small amelioration.

Photopsy, or the appearance of luminous spectra before the eyes, is a common symptom in glaucoma. It arises from pressure on the retina by the congested choroid. Such spectra may continue to present themselves even after sight is lost. From seeing them, the patient is apt to flatter himself with the delusive hope that sight is still in the eye and may yet be restored.

The hardness of the eyeball in glaucoma has appeared to me to be owing sometimes not alone to intraocular distension, but also to extraocular pressure, arising from a condensation and shrinking with loss of elasticity of the tissue of the sclerotica. This view, I find from the French translation of this work, has also suggested itself to M. Cusco, who designates this extraocular pressure *concentric*, whilst to the intraocular distension he gives the name of *excentric*.

I have said that arthritic posterior internal ophthalmia is identical with what is named acute glaucoma.

In its typical form glaucoma is a chronic affection, and presents itself in various degrees of development: from that degree in which the patient's attention is drawn to his eyes only by experiencing an occasional dimness of sight, by seeing luminous spectra on stooping, perhaps more readily than usual, and by a feeling of fullness in the globe; from that in which, if the patient be led by the subjective symptoms I have enumerated to take advice on his case, the medical man, on examination, will find the eyeball unnaturally hard to the touch, the sclerotica dark-looking, the veins on the white of the eye I have before spoken of, turgid and tortuous; the iris inclined towards the cornea, and, behind the rather dilated and sluggish or immovable pupil, the characteristic greenish appearance as if of opacity. From such a degree to the degree in which the sight is very much impaired or altogether lost,—in which luminous spectra may, notwithstanding, still be seen,—in which there is pain in the eyeball and around the orbit,—in which, behind the much and irregularly dilated pupil, the medical man sees, on examination, the glaucomatous opaque appearance strongly marked, if there be not actual glaucomatous cataract,—in which the tissue of the sclerotica, besides being dark and dirty-looking, presents here and there a condensed and whitish aspect,—in which the turgid veins are unusually large and tortuous,—in which the iris itself is pervaded with tortuous veins, though properly speaking, not inflamed,—in which the eyeball is of stony hardness,—in which the cornea is dim and rough, perhaps with its epithelium occasionally rising up in the form of large phyctenulæ,—in which, lastly, sclerotic staphyloma presents itself, perhaps in some part of the front of the eyeball.

In the course of the disease, intraocular hæmorrhage may occur. The extravasated blood may be in the substance or on the surface of the retina, and may extend into the vitreous body. Sometimes blood shows itself in the aqueous chambers, or in the interstices of the cornea.

The various organic alterations in the eye, with the corresponding subjective symptoms, in chronic glaucoma which I have now recapitulated, take place more or less gradually; and it may be, perhaps, only after many months that the extreme stage of development is attained. The acute form of glaucoma, on the contrary, is of sudden invasion and rapid development, though, be it remembered, that the affected eye may not have been for some time previously altogether sound, nor the patient's general condition satisfactory.

At the commencement of an attack of arthritic posterior internal ophthalmia, or acute glaucoma, there is often vomiting. The vascular injection of the eye, both sclerotic and conjunctival, is great, and of a purplish tint. There is excruciating pain all over the side of the head. The sight rapidly fails, and may perhaps be lost in a single night. The cornea is dim and rough, and the other characters of glaucoma present themselves in an exaggerated degree.

As glaucoma is a disease of advanced life,—occurring especially in persons of broken health, gouty constitution, affected with abdominal congestion, or labouring under hæmorrhoidal disease,—we can readily understand, keeping in mind its special pathology, how that affection of the eye should prove so rebellious to treatment.

The right eye of a man was operated on by iridectomy for chronic glaucoma. Though no improvement of the sight took place, the man expressed his belief that his left eye had gained in strength since the operation on the right.

This gain for the left eye, however, did not prove of long continuance; for the man presented himself about three months after the operation on the right eye—with an attack of arthritic posterior internal ophthalmia, or acute glaucoma of moderate severity of the left eye. On this eye, I performed iridectomy. On the night of the operation, and for two nights following, the patient took a pill containing two grains of calomel, one grain of extract of colchicum, and one grain of opium.

As a result of the operation and this treatment, the inflammation and pain began to abate and the sight appreciably to improve. In proportion as the blood, which was effused in considerable quantity into the aqueous chambers at the time of the operation, became absorbed, this improvement of sight advanced so far that about ten days after the operation, the man said that he could see all round about him much better than he was able to do before. Unfortunately, however, there supervened, without any evident cause, a new effusion of blood into the aqueous chambers, whereby the improvement of sight such as had been gained, was to some extent lost. The application of leeches to the temple, however, promoted the absorption of the effused blood, so that the improvement of the sight was regained.

This spontaneous effusion of blood, it may here be remarked, exemplifies the tendency to intraocular hæmorrhage in glaucoma, above spoken of.

How did excision of a bit of iris act in producing the result just described?

Iridectomy is commonly said to operate beneficially by removing intraocular distension, and thus relieving the retina and ciliary nerves from pressure. No doubt it appears to produce some such effect, but how does it operate in removing the intraocular distension? is the question.

On the assumption that the surface of the iris is the principal source whence the aqueous humour is exuded, iridectomy has been said to remove intraocular distension by diminishing the extent of the exuding surface, and thus setting a limit to the accumulation of aqueous humour. We have, however, seen that whatever good iridectomy may do in the way of diminishing intraocular distension, it cannot be by removing a source of the aqueous humour, because we have shown (p. 150) that the iris has little if any share in secreting aqueous humour. And it is evident that if it had, the removal of so small a portion of that membrane would not be likely to produce any great impression on the quantity of aqueous humour exuded. We have, moreover, seen that in glaucoma the intraocular distension is not owing to an increase in the quantity of aqueous humour, but that, on the contrary, it has its seat in the posterior segment of the eyeball.

An opinion has been expressed to the effect that iridectomy, by establishing a larger and freer communication between the two chambers of the aqueous humour, promotes the diminution of intraocular distension. The force of this opinion, however, I cannot see, even supposing what has been just denied, that the distension has its seat in the aqueous chambers.

In reviewing our case in order to discover what can be ascertained from it in explanation of the *modus operandi* of iridectomy, we must not overlook the effect of the preliminary section of the cornea, and the evacuation of the aqueous humour that takes place, in relieving the tension of the eyeball at the time. We all know what relief to tension is elsewhere afforded by an incision through a fascia investing a congested or inflamed part; and alhough undue accumulation of aqueous humour is not, as we have seen, a cause of the distension of the eyeball n glaucoma, still the evacuation of the aqueous humour must contribute for so much to the relief of the distension.

Let us now direct attention first to the operation on the right eye. The blood effused into the aqueous chambers became speedily absorbed, and the eye quickly recovered from the effects of the operation, but no restoration o sight took place. The left eye, however, as we have seen felt stronger, and the man could exercise the sight of i better.

According to the view of the pathology of glaucoma which I have expressed, this result of the iridectomy on the right eye might be explained as follows :—

The intraocular venous congestion was relieved by the operation—in what manner I have above endeavoured t explain (p. 154)—and the circulation of the blood within the eyeball being thus rendered freer, absorption of superabundant fluid in the cells of the vitreous body was favoured, so that altogether the intraocular distension was diminished. But it may be asked : if so, why was sight not restored ? The answer to this, I suppose, must be that the retina had already sustained so much material organic injury from the combined congestion and pressure, that on the diminution or removal of the distension it was no longer fit to resume its function, though the pain was relieved.

The relief of the right eye, however, from congestion and distension, reacted by sympathy—or whatever other name we choose to employ to designate that influence which the condition of one eye undoubtedly exerts on the other—in a favourable manner on the left eye, so that what intraocular congestion and distension existed there, were for the time ameliorated.

But as the patient was a person far advanced in life, and presented indications of a gouty constitution and broken health, we have no reason to be surprised that the amelioration in the condition of the left eye should have been for a time only, and that under the unfavourable circumstances of severe and variable weather, the left eye should have become inflamed, and that the inflammation should have been what is called arthritic posterior internal ophthalmia, or acute glaucoma.

From the iridectomy on this eye, more was gained for its sight than there was from the operation on the right eye for its sight.

We have seen that it is in acute glaucoma that most benefit to sight is derived from iridectomy. This effect, such as it is, must, in my opinion, be looked for in the circumstance that the disease not having been of long standing, the retina may not as yet have suffered material organic change, and, therefore, is still capable of resuming to some extent its function on being relieved from pressure by the subsidence of the inflammatory congestion, and the consequent absorption of superabundant fluid in the posterior segment of the eyeball.

Although by iridectomy, the inflammation was, in the case of acute glaucoma under notice, subdued and the sight somewhat improved, there was not a restoration of what may be called *good sight*. In chronic glaucoma, the result of iridectomy is much less favourable. We have only to look through the table of cases in the Ophthalmic Hospital Reports (No. 10, January, 1860), to be satisfied of the inefficiency of the operation in chronic glaucoma.

It is thus perceived how unfounded the claim is which has been set up for iridectomy as an unconditional cure for glaucoma.

The operation, however, proves a useful auxiliary in the treatment of arthritic posterior internal ophthalmia, or, as it has been called, acute glaucoma. And here it may be said, *remedium anceps melius quam nullum*.

We have seen that there are certain symptoms premonitory of glaucomatous failure of sight. In such a case, iridectomy has been especially recommended as a prophylactic of the threatened mischief.

If, under such circumstances, it should be thought warrantable to propose the operation, we ought to do so only with great reserve, as we cannot truly give our patient an assurance that the operation will have the desired effect of preserving his sight.

That iridectomy and extraction of the lens combined may not permanently secure the eye against an attack of acute glaucoma, was shown by a case of cataract I treated in the hospital some years ago. The patient was a woman about sixty years of age, and the eyes were at the time otherwise quite healthy. I performed extraction on one eye, and in making the section of the cornea, the iris, in consequence of a premature escape of the aqueous humour, fell before the edge of the knife, and a very considerable piece of it was cut out. The lens was easily extracted, and the case did well. The eye, indeed, recovered so rapidly that the patient was able to leave the hospital within ten or eleven days after the operation. Having been fitted with cataract glasses, the woman enjoyed capital sight, and continued to do so for some two or three years. At the end of that time, she one day presented herself at the Eye Infirmary, complaining that the sight of the eye was totally gone. She stated that the eye had been inflamed for some ten days past, and that she had been suffering severe pain in the head all that time.

On examination, I found the eye—the eye on which both iridectomy and extraction had been performed—hopelessly glaucomatous.

Suppose this patient had been seen earlier in the attack, would a second iridectomy have saved the eye? It is not likely; but if so, it is evident that the eye could not bear much further repetition of it, for the good reason that there would be at last little of the iris remaining to cut away.

This suggests the question, Are persons with congenital absence of the iris liable to glaucoma? Such persons are rare, and I have never seen one affected with glaucoma exactly, though I have seen one attacked with internal inflammation of the eye of somewhat arthritic character, after an operation for cataract. This was the case above mentioned (p. 150), in which, after *paracentesis corneæ*, the aqueous humour was as quickly and completely regenerated as usual. I do not, however, suppose that congenital absence of the iris offers any immunity against glaucoma. If so, what could an iridectomist do in case of an attack?

Iridectomy, we have seen, may be advantageously performed in certain cases of chronic anterior internal ophthalmia, with extensive adhesion of the pupillary margin of the iris to the capsule of the lens. Here we can understand that one effect of the operation is really to establish a freer communication between the anterior and posterior chambers of the aqueous humour.

The operation is also had recourse to in the hope of warding off the relapse of gonorrhœal iritis, to which some persons are so painfully subject. That iridectomy, however, may not secure the eyes against even a first attack of gonorrhœal rheumatic iritis, is shown by the case above related (p. 221).

CHAPTER VI.

SECTION I.—LOSS OF CORRESPONDENCE OF THE SENSATIONS AND MOVEMENTS OF THE TWO EYES.

As an introduction to the present subject, the correspondence which naturally exists between the sensations and movements of the two eyes, requires to be taken into consideration.

1st.—*Correspondence between the sensations of the two eyes.*

It has been above shown (p. 525, et seq.) that the different parts of the same retina exert an influence on each other's sensations. The two retinæ, it is here to be shown, likewise exert an influence on each other's sensations, but to a much greater and more striking degree.

When the two retinæ are impressed in a similar manner at the same time, the resultant sensation is much stronger than when one eye only is employed. If the impression on one retina be indistinct, whether from suffusion of the transparent media of the eye or from impaired sensibility of the retina, the indistinctness of vision which results, is not so evident when the other eye is used at the same time, as when the affected eye alone is used.

When the two retinæ are affected in a dissimilar manner at the same time, the mind does not perceive an admixture of the two sensations, but perceives the sensation of one of the retinæ only at the same instant of time. Sometimes the one, sometimes the other. If, however, the impression on the one retina be much the stronger, it decidedly predominates over, or excludes the other from the mental perception.

2nd.—*Outness of visual perception.—Erect vision.—Single vision with two eyes.—Visual perception of the three dimensions of space.*

In the act of seeing, we refer our perceptions to without, and to some distance from the eye,—to the place where the object is, whence the rays of light making the impression emanated. In this respect, sight differs from touch; for we refer our tactile sensations to the part of the skin impressed. In this peculiarity of sight we may perceive an adaptation to the means by which the retina is impressed—viz., not directly by the object, as the skin is in touch, but only through the medium of the rays of light proceeding from the object. In thus referring our visual perceptions to without, and to some distance from the eye, we take no cognizance of the fact that the impression exciting the sensation is actually made on the retina, nor of the nature of the intervention of the impressing agent, light.

This faculty of *outness* of visual perception is owing to an original inborn law of our minds, and not, as has often been maintained, on experience and association acquired through the sense of touch. In support of what is here advanced, the sense of touch itself affords an illustration—viz., the well-known fact that persons who have had the misfortune to lose a limb sometimes feel as if the lost organ were still in connection with the body, and that some part of it, perhaps, is the seat of pain. Thus, to quote from the "Spectator," "The poor fellow, who lost his arm last siege, will tell you he feels the fingers that were buried in Flanders ache every cold morning at Chelsea." This is an example of a tactile sensation referred by the mind, under abnormal conditions, not to any part of the existing body, but to without and to some distance therefrom, just as a visual sensation is, under normal conditions, referred.

The direction outwards in which the mind refers its visual perceptions is that of the axis rays of the cones of light which make the impression. The mind, therefore, in referring its visual perceptions outwards, does so to the side opposite that on which the impression is made on the retina. Thus, if the impression is made on the lower part of the retina, the sensation resulting therefrom is referred to a point without and upwards—to that part of the object, in fact, whence the rays making the impression come. If the impression is made on the upper part of the retina, the sensation resulting therefrom is referred to a point without and downwards. And so on—if on the right side of the retina, to a point without and to the left; if on the left side, without and to the right. Though it is thus outwards in the direction of the axis rays of the cones of light, making the impression, that the mind refers the sensation, it is proper to observe that this in no way depends on the direction of the rays of light; for if the axis rays be prevented from entering the eye, the same effect nevertheless follows the impression by any of the circumferential rays alone, the direction of which is different. Besides, a luminous spectrum excited by an impression on the retina independently of light—by direct pressure, for example—appears to us, in like manner, projected to without, and to the side opposite that where the pressure is applied.

It is on this law, which has been named the *law of visible direction*, that our seeing objects upright as they are depends, notwithstanding that, in conformity with the laws of light, the pictures of external objects projected on the retina by the dioptric apparatus in front of it are necessarily inverted—in other words, erect vision, notwithstanding that the impressions on the retina are inverted. In this law, we have an additional example of the adaptation of the physical endowments of the retina to the optical conditions under which external objects make their impressions on that nervous expansion.

Single vision with two eyes is also dependent, in part at least, on the law of visible direction.

As the rays of light emanating or reflected from the different points of a visible object proceed in all directions, and in straight lines, those from the same points must, necessarily, some of them, enter the one eye and some the other, and so impress both retinæ in the same manner and at the same time. From these two impressions, it is to be observed, we have not a double perception of the object, but only a single one, provided the two eyes be naturally directed,—that is, provided their optic axes intersect at some point of the object, provided their centres of revolution coincide, and provided their horizontal and vertical diameters are respectively parallel. When the two eyes are thus naturally directed, the parts of the two retinæ which receive similar and simultaneous impressions from the rays of light entering them from given points of the object are the various parts of the right half of the one retina, and the various parts of the left half of the other retina, equally situated in relation to their vertices or central points. These parts of the two retinæ, as similar and simultaneous impressions on them yield but a single visual perception, are named *cor-*

responding or *identical parts*. If the two eyes are not directed in the natural manner above described, the rays of light from a given point of the object will not then fall on corresponding parts of the two retinæ, and the consequence will be that the two impressions will be perceived by the mind separately, and the object will appear double,—that is to say, two images of the object will be seen, each being referred by the mind to a different place in the field of view.

Amidst the various movements of the eyeballs, the correspondence in direction necessary for single vision is maintained by the concurrent action of their muscles.

In accordance with the law of visible direction, the mind, in referring a sensation excited by an impression on the retina to without and to some distance from the eye, does so in a direction depending on the part of the retina impressed. Now, when similar impressions are simultaneously made on corresponding parts of the two retinæ, the two similar sensations resulting from the impressions are referred by the mind outwards to one and the same place. The image seen by the one eye, thus coinciding with that seen by the other, the object appears single. This, so far as regards distant objects, is true; but there are other considerations to be taken into account in explanation of single vision with two eyes. The images of a near object, viewed by each eye separately, are not referred by the mind to exactly one and the same place: —that is, the right eye, when the left is shut, sees the object a little to the left of the place where it appeared to the two eyes to be; and the left eye, when the right eye is shut, sees the object a little to the opposite side. As soon, however, as the two eyes are in simultaneous action, the two images come to be referred to the same place. When the two images are thus referred to one and the same place, and consequently appear run together into one, it cannot exactly be said that they are superposed merely; for we know that the two dissimilar perspective images of an object of three dimensions, or the two figures of a stereoscopic slide, are seen as one, though that one is like neither of the perspective images. In this case there must be a mental combination of the two into one.

A superposition of two images does, indeed, appear, as above mentioned, to take place, if they are quite different from each other, either in respect to colour or shape.

Thus, when impressions different in colour, though of the same shape, are made on corresponding parts of the two retinæ,—which may be done by means of a stereoscope and a blank slide on which a blue wafer has been stuck on the one division, and a yellow wafer on the other,—the images of the two wafers run together, and one round spot is seen, but an admixture of the two colours does not take place. The spot appears either blue alone or yellow alone, at the same instant of time, as if the image of the one wafer was merely superposed over that of the other. Sometimes, however, the blue is seen in part, and the yellow in part, as if portions of the superposed wafer had vanished, allowing of portions of the subjacent one to be seen through. If the colour of the one wafer be much more brilliant than that of the other, so that the impression on the one retina is more striking than that on the other, the more brilliant colour prevails or excludes the other altogether from the mind's perception. When the impressions are entirely different in shape, though of the same colour, the images are perceived to alternate in a similar manner, unless the one be much more striking than the other, in which case it also, like the brightest colour, predominates, and the other is not perceived.

As the dissimilar perspectives of an object of three dimensions or the two figures of a stereoscopic slide cannot all fall on exclusively corresponding points of the two retinæ, it follows that it is not an indispensable condition for single vision that every part of the impression on the two retinæ be made on exactly corresponding *points*. Still, if the non-correspondence of the points of the two retinæ impressed be beyond certain limits, there is double vision.

In elucidation of the question of corresponding points, it is to be observed that, as above pointed out (p. 526), the retina is endowed with the greatest sensibility in the region of its vertex, or central part. Thence, towards its circumference, the sensibility diminishes. In consequence of this, we see very distinctly only that part of an object to which the axes of the eyes are at the moment turned.

Thus it is, that though the mind perceives separately impressions on neighbouring non-corresponding points of the two retinæ in the region of the vertex or most sensitive part, at the same instant of time, it does not perceive separately impressions on neighbouring non-corresponding points at the circumferential and less sensitive parts of the retinæ. It perceives merely a sensation as if one impression were made, and that not a very well defined one—a sort of mean of the two.

To apply what has just been said of the difference in the degree of sensibility which the retina presents from its centre to its circumference, to the question of single vision with two eyes:—In viewing an object of three dimensions with the optic axes convergent, it is that part of it at which the optic axes intersect, the image of which is projected on the central part of each retina. Now, of the perspectives of the object which are projected on the two retinæ, this is the only part which is similar for the two eyes. The impression of the image of this part of the object, therefore, is confined to corresponding points, which is the condition necessary for a single visual perception from an affection of the central parts of the two retinæ. It is, on the contrary, those parts of the object lying out of the *horopter*—an imaginary spheroidal surface, the circumference of which cuts the point of intersection of the optic axes, on the one hand, and the points of intersection of the lines of visible direction within the two eyeballs, on the other—the image of which, necessarily dissimilar for the two eyes, is projected on the circumferential parts of the retinæ; the very parts, affections of accurately corresponding points in which are not, as above seen, a necessary condition for a single visual perception.

The preceding disquisition on single vision with two eyes has prepared us to enter upon the examination of the nature of stereoscopic vision, or the visual perception of the three dimensions of space—length, breadth, and thickness—or solidity and depth.

All that can be perceived of solidity or depth by means of one eye may be represented by painting on a plain surface; but it is not so in regard to what can be seen of them by means of the two eyes whilst their axes are in a state of convergence. In the former case, a *semblance* of solidity or depth is seen; and this is all that a picture can represent: in the latter case, solidity or depth is perceived as really as it may be by the touch of two fingers: and this is what a single picture cannot represent. The perception of solidity or depth is owing to the position of the two eyes in the head at some distance apart, whereby each is fitted to receive on its retina a different perspective of the object, whilst the mind, in conformity with an original inborn law of the economy, does not perceive two superposed dissimilar images, but only a single one, and that, unlike either of the two perspectives, in full relief or intaglio, as the case may be.

When the object looked at is so very distant that the axes of the eyes are little or not at all convergent, not more of solidity or depth is seen with the two eyes than can be seen with one only; for in this case the perspectives received by the two eyes are not dissimilar. The appearance of the object, as thus seen, might, therefore, be represented on a plain surface.

When the object is not so very distant but that the axes of the eyes require to be converged towards it somewhat, and yet not so very near as to require any great degree of convergence, we have a proportionate degree of stereoscopic vision.

Our faculty of perceiving the three dimensions of space—length, breadth, and thickness—used to be attributed by philosophers solely to the touch; the perception of solidity or depth by the eyes being, they supposed, a faculty acquired merely by experience through that sense. It is quite true that, by the active exercise of touch—by moulding the hand around a solid body—we recognise its three dimensions. It is also quite true, that using one eye only in vision—or even two eyes, if the object be very distant—though we may infer that an object presents length, breadth, and thickness, the appearance of solidity or depth is not bold or striking, and is such as can be represented by painting on a plain surface. The judgment as to the three dimensions by vision with one eye—or even with the two eyes, if the object be very distant—cannot, therefore, be depended on. But, on the other hand, it is quite true—and this is to be particularly remarked—that though by moulding the hand around a solid body we can recognise its three dimensions, we cannot by simple touch—that is, by contact of the skin with a solid body—recognise any more than the two dimensions of length and breadth. Again, it is also quite true that though by means of one eye we can recognise truly length and breadth only, we can, if we look with the two eyes at a solid body near us, perceive its three dimensions of length, breadth, and thickness, as certainly and demonstrably as we can by the touch when moulding the hand around the object.

The faculty of perceiving the three dimensions of space with the two eyes implies the faculty of recognising, by the same means, the distance and position of objects looked at with the optic axes in a state of convergence. Whilst, with the two eyes, objects and their several parts are seen fixed, as it were, each in its own position and at its own distance, the same is not the case with one eye. We cannot, for instance, with one eye only so perceive position and distance as to be able accurately to pour wine into a glass, snuff a candle, or perform the like operation. With one eye, indeed, we cannot even, under all circumstances, distinguish between relief and intaglio. Thus, if we look with one eye fixedly on the intaglio of a seal from which the light is shaded, the design will sometimes appear as if in relief; but as soon as we open the other eye, the illusion is dissipated, and the intaglio becomes unmistakeably evident. As in viewing very distant objects with the two eyes the optic axes are not convergent, the perspectives received by the two retinæ are similar: we, therefore, do not perceive more of their three dimensions than we can with a single eye. We cannot, accordingly, even with the two eyes, determine with great exactness the relative position and the projecting or receding of distant objects.

3rd.—*Natural double vision with two eyes.*

It is to be remarked, that we do not see with the two eyes every object single; and the reason is, that the more projecting, for example, an object is, the more is some part of it out of the horoptor, and therefore the more dissimilar are its perspectives to the two eyes. Now, when the pictures on the two retinæ are very dissimilar, the parts which ought to coalesce occupy places far beyond the limits at which points of the two retinæ are influenced by each other; and therefore an object, such as a needle, for instance, looked at with one end directly towards us, is seen bifurcated or double.

4th.—*Correspondence in the movements of the two eye-balls.*[*]

A correspondence in the direction of the optic axes, coincidence of the centres of revolution, and parallelism of the vertical and horizontal diameters of the two eyes, it has been above shown, are necessary conditions, in order that the images of objects may be simultaneously projected on corresponding points and parts of the two retinæ; that they are therefore the remote conditions on which single vision with the two eyes depends. In the course of the movements of the eyeballs, these conditions must therefore be preserved.

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[*] Ruete, Lehrbuch der Ophthalmologie für Aerzte und Studirende, Braunschweig. 1845.

The eyeball lies balanced, as it were, in the orbital capsule, and the movements which it is made to execute by the action of its muscles are revolutions merely around a certain point in its interior, the situation of which in the orbit always remains the same when the movements of the eyeballs are natural.

As the eyeball revolves in all directions, it has three axes, on which it is made to revolve by its six muscles, in as many different primary directions.

Suppose the six muscles of the eyeball in a state of equilibrium, by which the pupil is directed exactly forwards, and the optic axis is horizontal; then :—

1st. The axis of revolution for the rectus externus and internus is vertical, and coincides with the vertical axis of the eye. These muscles turn the pupil outwards or inwards.

2nd. The axis of revolution for the rectus superior and inferior, is horizontal, and, (inasmuch as these muscles proceed to the globe in the direction of the optic nerve, which intersects the optic axis at an angle of about twenty degrees,) extends obliquely from before and inwards, somewhat backwards and outwards, intersecting the optic axis at an angle of about seventy degrees. The pupil is thus turned by the rectus superior upwards and somewhat inwards, by the rectus inferior downwards and somewhat inwards.

3rd. The axis of revolution of the obliqui likewise extends horizontally through the eyeball, but nearly from the outer margin of the cornea backwards and inwards, and intersects the axis for the superior and inferior recti at an angle of about seventy-five degrees. Around this axis, when the optic axis is horizontal and directed forwards, the superior oblique turns the eyeball in such a way that the pupil is directed downwards and outwards, and the inferior oblique turns it in such a way that the pupil is directed upwards and outwards. The annexed figure (Fig. 140) represents these points.

The oblique muscles turn the eyeball in the direction above indicated, only when the pupil is previously directed straight forwards, and all the muscles are in a state of equilibrium. But if, for example, the internal and inferior recti have previously directed the pupil downwards and inwards, then the superior oblique turns it still more inwards.

The oblique muscles can rotate the eye round its visual line, but not by a voluntary effort. The involuntary action comes into play in order to combine the images, under certain conditions of binocular vision, as has been shown by Professor Helmholtz.

The four recti are antagonists of the two obliqui: the recti muscles pull the eyeball back, the obliqui forwards. The eyeball is in the sound state thus balanced.

If one of the four recti muscles be cut, the eyeball protrudes somewhat. When one of the obliqui is cut, the eyeball sinks deeper in the orbit.

The two obliqui, with the external rectus, are antagonists of the superior, inferior, and internal recti.

By the mechanism just mentioned, assisted by the orbital capsule, the eyeball is balanced in such a way that when all the muscles are in equilibrium the optic axis is directed horizontally forwards.

The four recti rotate the eyeball in the vertical and horizontal directions. The obliqui, by moving the eyeball on their rotation axis, and involuntarily rotating the eye round its visual line, keep the vertical diameter of the two eyes always parallel though not vertical—one of the conditions necessary for single vision.

The internal rectus muscle of one eye, and the external rectus of the other, usually act together, so also do the superior recti of the two eyes and the inferior recti.

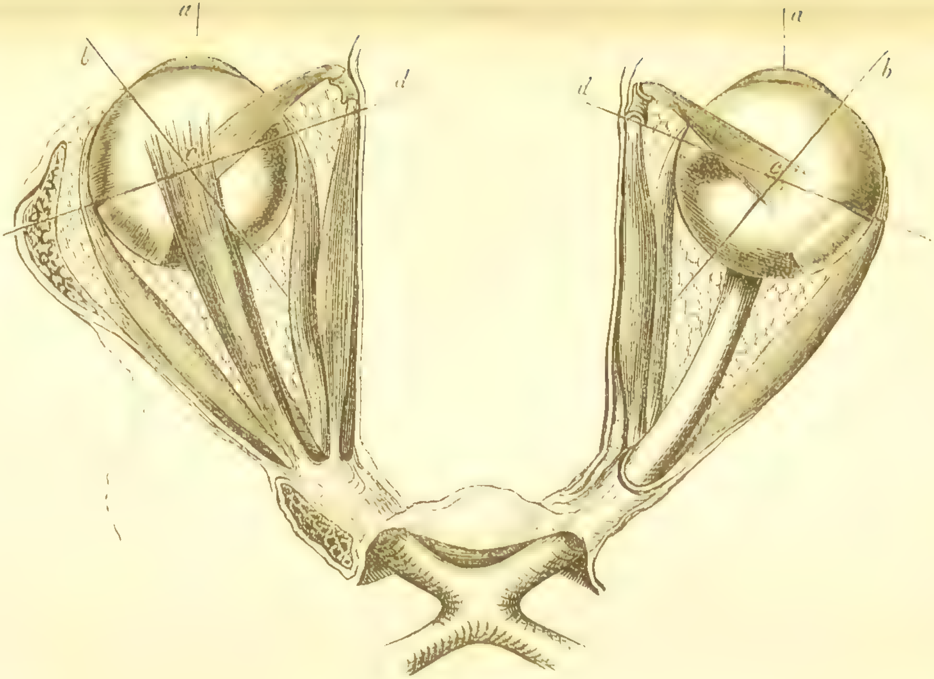
But when required for the purposes of vision the two internal recti act together, and so also may the two external recti in bringing the visual axes or lines from a state of strong convergence to a state of parallelism, but not of divergence.

In short, the different muscles of the two eyeballs act in various combinations, sometimes as fellows, sometimes as antagonists, according to the manner in which the eyes require to be directed to receive the images of the object looked at, on corresponding parts of the two retinæ.

Fig. 140.

(From Ruete.)

The muscles seen from above are in a state of equilibrium; *a a* the parallel visual axes or lines; *c c* the centres of revolution; *b b* the axes of revolution for the oblique muscles; *d d* the axes of revolution for the superior and inferior recti.



5th.—*Summary of the combined actions of the muscles of the eye.**

1st and 2nd. Rotation of the cornea in the horizontal direction inwards and outwards, is effected by the internal and external recti.

3rd. Rotation directly upwards is not effected by any one muscle, but is so by the combined action of the superior rectus and the inferior oblique.

The superior rectus alone rotates a little inwards, and the inferior oblique alone a little outwards, at the same time that they respectively turn the eye upwards or downwards.

4th. Rotation directly downwards is effected by the conjoined action of the inferior rectus and superior oblique.

5th. For the diagonal position inwards and upwards, the rectus superior must co-operate with the rectus internus; whilst the obliquus inferior has to counterbalance the too strong action of the rectus superior on the inclination of the meridian.

6th. The diagonal position inwards and downwards is produced, in like manner, by the combined action of the rectus inferior and rectus internus, with the concurrence of the obliquus superior.

7th. To bring the eye into the diagonal position outwards and upwards, the rectus externus co-operates with the two levator muscles.

8th. To bring the eye into the diagonal position outwards and downwards, the rectus externus co-operates with the two depressor muscles.

LOSS OF CORRESPONDENCE IN THE SENSATIONS OF THE TWO EYES.

1st.—*Diplopy or double vision with two eyes.*

The conditions on which single vision, as well as natural double vision with the two eyes depends, having been premised, we are prepared to enter upon the study of morbid double vision with two eyes.

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* Dr. Adolf Waldau, Zur Lehre von der Wirkung und Lähmung der Augenmuskeln. Berlin, 1862.

In limine, it may be observed, that double vision with two eyes is altogether different in its nature from the double or manifold vision with a single eye above considered, the latter being owing to irregular refraction. A case of double vision with two eyes is at once distinguished by closing one eye, when objects will be seen single.

When, from any cause, there is loss of the natural correspondence of the optic axes, coincidence of the centres of revolution, and parallelism of the vertical and horizontal diameters of the two eyes, the parts of the two retinæ, on which images of the same objects are simultaneously projected, are not corresponding or identical; therefore, in accordance with what has been above said, the sensations arising from the two impressions are separately perceived by the mind, and the consequence is double vision.

Double vision with two eyes is thus in itself not a disease, but the natural result of derangement of those conditions on which single vision depends. The proximate cause of the derangement alluded to is, most frequently, paralysis of some one or more of the muscles of the eyeball; but it may be some morbid production in the orbit, or the like, displacing the eyeball.

The two images in diplopy are often distinguished into true and false, or real and imaginary; but such a distinction is improper, as the image perceived by the displaced eye, although it may be less distinct, is not more false or imaginary than the other, both being equally the result of sensation produced by the impression of rays of light on the retinæ.

That one of the two images is more distinct than the other, is owing to the circumstance, that in one eye the impression is made on the central part of the retina, which is more sensible than any other; while in the opposite eye, the impression falls on a part of the retina, which according to the degree of deviation of the eye from its right direction, is more or less distant from the centre. The adjustment of that eye, moreover, which receives the impression on the centre of its retina, corresponds with the distance of the object looked at. The other eye, not being so adjusted, its image besides being indistinct, is surrounded by an iridescent halo (p. 506, 2nd).

The relative position of the two images depends upon the direction and degree of the deviation of the eyes.

Thus: when one eye is turned inwards, its image is on the same side (*homonymous diplopy*); when turned outwards, it is on the opposite side (*crossed diplopy*). Again, the two images are seen, side by side, at a greater or less distance from each other, when the deviation depends on paralysis of the internal or external rectus;—one above the other, when the deviation depends on a non-correspondence in the action of the superior or inferior rectus;—one appearing obliquely placed in respect to the other, when the superior oblique is paralyzed.

As the deviation of the axes or centres and diameters of the eyes exists only when the person looks in particular directions and at certain distances, so does the double vision in such cases take place only when the patient looks in those directions, and at those distances; thus, if the abductor muscle of the right eye be palsied, the patient sees single on looking to the left, but double on looking to the right;—if the adductor, the contrary; if the superior oblique, the patient sees single when he leans his head forwards and at the same time rotates it somewhat to the opposite side, but double on looking downwards.

When double vision is owing to deviation of the optic axes, the misdirection of the two eyes may exist in various degrees, from an evident squint to a scarcely perceptible cast.

When, on the contrary, double vision is owing to deviation of the vertical and horizontal diameters of the two eyeballs from parallelism, in consequence of abnormal action of one of the oblique muscles, there is not so much deviation of the optic axes, and, consequently, little apparent squint or cast, except on looking downwards.

The irregular or impeded action of the muscles of the eyeball, giving rise to diplopy, may be owing to an affection of the muscles themselves or of their nerves, or it may be owing to disease or injury of the brain, or to drunkenness, or fear, or to derangement of the *primæ viæ*, &c. But this is not the place to discuss those various primary affections on which the derangement of the action of the muscles of the eyeballs depends. It is enough here to explain the nature of diplopy with two eyes, in order that, as a symptom in any particular disease, it may be appreciated at its due value.

2nd.—*General diagnosis of paralysis of the muscles of the eye.*

We, first, note the position of the eyes of the patient while, with his head fixed, he looks at an object which we move slowly before him from one side to the other, and from above downwards.

We next cover one eye, and then the other eye, and make the same trials on each. At the same time we take notice how the covered eye is directed, while the other fixes the object.

Having thus discovered which eye is affected, and determined the symptoms of vertigo, and the errors in the projection of the field of vision which arise from the closure of the sound eye, we have recourse to the testing of the double images, which is a means calculated to afford us exact information as to the slightest deviation of one eye.

If the eye is turned in, the impression is made on the inner part of the retina, and the projection of the image is to the temporal side; so that the left image belongs to the left eye, and the right to the right. If, on the contrary, one eye is turned out, the impression is made on the temporal side of the retina, and the image is projected inwards to the nasal side, and thus crosses the other. Hence, the right hand image belongs to the left eye, and the left hand image to the right eye.

For the same reason, a deviation of the visual line downwards gives an image seated above the level of that of the sound eye; while in a deviation upwards the image of the misdirected eye is below that of the sound one.

If the visual line is not straight inwards, or downwards, but turned in the diagonal direction, the corresponding deviation of the double image is also observed.

3rd.—*Paralysis of the muscles supplied by the nerve of the third pair.*

The result of paralysis of the muscles supplied by the nerve of the third pair, viz., the levator palpebræ, the internal, superior, and inferior recti, the inferior oblique and the sphincter fibres of the iris, is:—

1st. Paralytic ptosis.

2nd. Paralytic divergent luscitas.

3rd. Paralytic mydriasis, and loss of adjustment for near sight.

Paralytic ptosis.—This is a hanging down of the upper eyelid over the eye, Fig. 141, in consequence of paralysis of its levator muscle permitting of the unrestrained action of the orbicularis palpebrarum. The patient can

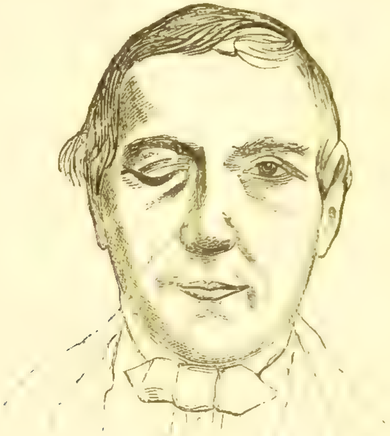

FIG. 141.

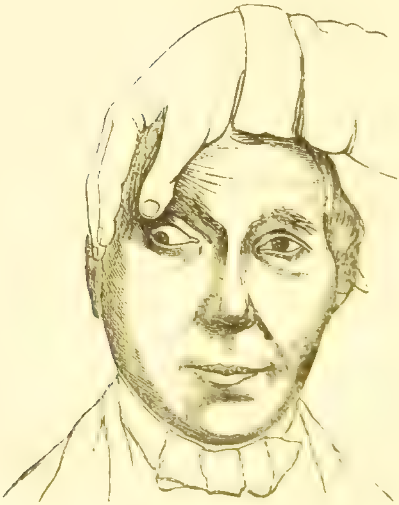

FIG. 142.

thus open his eye only by raising the eyelid with his finger. Fig. 142.

Paralytic divergent luscitas.—When the upper eyelid is raised with the finger, the eye is seen to be turned rather outwards and sometimes downwards, Fig. 142, in consequence of the paralysis of the internal, superior and inferior recti permitting of the unrestrained action of the external rectus, and paralysis of the inferior oblique permitting of the unrestrained action of the superior. The patient is at the same time unable to move the eye upwards or downwards. From the non-correspondence of the two eyes occasioned by the eversion, the patient sees double, especially when he looks to the opposite side, and is apt to become giddy if he attempts to walk while he holds the eye open. By looking and leaning the head to the same side, the double vision ceases.

Mydriasis, and loss of adjustment for near sight.—As above explained, mydriasis is persistent dilatation of the pupil, notwithstanding exposure to light, owing to the paralysis of the circular fibres of the iris permitting of the unrestrained action of the radiating ones (p. 446), whilst the loss of adjustment for near sight is owing to paralysis of the muscular fibres subservient to that function.

It is to be observed, that any one of these three different states may exist separately. The ptosis without immobility of the eyeball; the immobility of the eyeball may not be accompanied by ptosis. Ptosis and immobility of the eyeball sometimes exist without mydriasis and paralysis of adjustment, but the two latter more frequently without the two former.

According to Dr. Donders, uncomplicated mydriasis with paralysis of near adjustment is more common in women and children, while general paralysis of the oculomotor is more common in men.

*Analysis of the phenomena attending paralysis of the internal, superior, and inferior recti of the left side.**—*Paralysis of the left internal rectus.*—If the patient fixes an object, which we move in a horizontal direction from left to right, the two visual lines are properly directed to about as far as the middle line. From thence, the left eye is misdirected outwards, and that the more the further we carry the object to the right. This pathological divergence appears somewhat sooner on turning the eyes towards the right when the patient looks upwards than it does when he looks downwards. If we cover the right eye with the hand, whilst the patient fixes the object with his left eye, the latter admits of being moved by jerks to the right beyond the middle line to the extent of about 10° or 15° by the vicarious action of the rectus superior and rectus inferior. Meanwhile, the right eye deviates under a still larger angle outwards, than previously took place at the corresponding situation from the affected eye. The patient complains, at the same time, of vertigo, and when he tries to reach the object, his grasp falls to the right side of it.

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* Dr. Adolph Waldau, op. cit.

In order to correct the diplopy, he turns his head so much towards the right, that he requires to look to the left at all the objects before him. On testing the double images, we find in the whole right half of the field crossed diplopia, that is, the image of the left eye stands to the right side. The distance between the two images increases, the further the object looked at is situated to the right. The line dividing that half of the field in which the vision is single from that in which it is double is inclined obliquely to the left.

The prism required to correct this displacement of the image of the left eye requires to be held with its base next the nose.

The double images are parallel and equally high: except in the diagonal positions to the right and upwards and to the right and downwards, where there is an obliquity and a difference in height,—the image of the left eye on looking towards the right and upwards being inclined to the right and lower—whilst on looking towards the right and downwards, it is inclined obliquely to the left and higher.

Paralysis of the left rectus superior.—The patient directs both eyes properly in the lower half of the field of view; but the more he looks upwards, the more does the visual line of the left eye remain misdirected downwards. At the same time, a slight divergence is perceptible. Whilst the affected eye is thus ill-directed, the sound one, while covered by the hand, turns upwards under a greater angle than that at which the affected eye previously turned downwards. When the patient tries to reach an object he passes it by above. In order to obviate the diplopy, the patient bends his head backward so that he may have always to turn the eyes downwards.

In testing the double images, we move the object in the vertical direction from below upwards. There then appear in about the horizontal visual plane crossed double images at unequal heights; of which that of the left eye is inclined obliquely to the right. The difference in height increases the further we move the object upwards. If, when the visual plane has reached a certain inclination upwards, we move the object in this plane from left to right, the difference in height of the double images reaches its maximum when the visual line is directed about 20° to the left, and diminishes in proportion as the patient has to look to the right. On the other hand, the obliquity of the one double image appears at first less evident, and becomes more considerable the further we move the object to the right. This is owing to the circumstance that the influence of the superior and inferior recti on the position of the cornea in respect to height increases, the more the visual line approaches the muscular plane; on the contrary, it causes greater deviation of the meridian the more the visual line approaches the rotation axis of these muscles.

The lateral distance between the crossed double images is greatest in the middle part, and diminishes on either side. As the difference in height towards the left appears earlier, the line, dividing the field of single from that of double vision, does not lie horizontal, but rises obliquely towards the right.

Paralysis of the left inferior rectus.—This is characterised by a series of symptoms altogether similar, only that they present themselves, of course, in the lower half of the field of view.

Paralysis of the left inferior oblique muscle.—This does not require to be particularly discussed, even supposing it were to occur alone; because, in looking upwards, appearances must of course present themselves, analogous to those which actually occur, in the lower half of the field of view, when the superior oblique is paralysed. See paralysis of the superior oblique.

Causes.—Paralysis of the parts supplied by the nerve of the third pair sometimes comes on under the same circumstances as rheumatism, viz., exposure to cold and damp. Such cases are properly viewed as being of a rheumatic character.

Paralysis of the muscles of the eye is often dependent on syphilis.

The cause of the paralysis, however, may be congestion, extravasation, effusion, a tumour, &c., consequent sometimes to blows or falls on the head, involving the intercranial portion of the nerve. In such cases both nerves are liable to be affected.

Rheumatic paralysis of the parts supplied by the nerve of the third pair soon developes itself after the exposure. Paralysis of the same parts, owing to intercranial disease, may according to the nature of that disease come on suddenly or gradually, and be accompanied with paralysis of other parts.

When all parts supplied by the third pair are paralysed, it is probable that the seat of the affection of the nerve is at or near its origin. When, on the contrary, certain parts only are paralysed, the disease probably implicates only certain peripheral branches of the nerve.

Prognosis.—Rheumatic or syphilitic paralysis is often cured, though it may yield but slowly. The same may be said of cases apparently owing to some cerebral affection, which have come on suddenly. In slow cerebral cases the prognosis is not only unfavourable, but the paralysis under consideration may be but a comparatively unimportant part of the case.

Treatment.—The plan of treatment in the rheumatic cases is the general antiphlogistic (p. 138, et seq.), consisting of bleeding, mercurialisation, and counter-irritation. According to the circumstances of the case, bleeding should be by venesection or leeches, or both; the mercurialisation should be pushed to decided affection of the mouth; the counter-irritation may be made by blisters to the crown of the head or over the brow. The same plan of treatment is applicable in sudden cerebral cases. But in slow cerebral cases the alterative plan of treatment with counter-irritation is the only one admissible.

A man, æt. 41. Oct. 14. About ten days or a fortnight ago severe pain in the left temple came on; from the temple it extended to the forehead of the same side, around the orbit, and down the side of the nose. The pain was much increased when warm in bed. Three days ago the upper eyelid of the same side became affected with paralytic ptosis, and the eyeball lost the power of being fully turned towards the nose. The pupil is not dilated, and contracts on exposure to light.

The skin of the forehead over the left eye is both warmer and more red than that of the opposite side. Tongue loaded—appetite bad—health generally has not been strong.

To take calomel (gr. iij.) and pulv. ipecac. comp. (gr. viij.) at bed-time; and after that calomel gr. j. with opium gr. ¼. twice a day. A blister to be applied behind the left ear.

16th.—To continue the pills and take a purgative draught to-morrow morning.

18th.—Feels decidedly better—raises the left upper eyelid more fully, but the eversion of the eyeball continues, so that he still sees everything double. Quite free from pain. Mouth much affected by the mercury. Appears to move the left eyeball inwards a little more than before.

To continue the pills and repeat the blister behind the ear.

21st.—Raises the upper lid nearly to the natural degree. Turns the eyeball more freely inwards, correspondence of the two eyes is, however, not quite perfect, as he still has double vision. The two images, however, appear less widely separated.

Mouth still much affected. Blister nearly well. Bowels free.

23rd.—The upper left eyelid admits of being raised nearly as well as the upper lid of the right eye, and the correspondence of the axes of the two eyes is now nearly complete, so that double vision is almost gone.

Mouth still very sore.

25th.—Continues to improve. To repeat the blister behind the ear.

28th.—He now opens the eye perfectly. The double vision is entirely gone. No pain in the head. Mouth still very sore, and strength sunken.

Nov. 6th. — Mouth a little better, but still is considerably affected. To take bark and soda powders three times a day. (Pulv. cinchonæ,—sodæ sesqui-carbonatis, aa. gr. v.)

8th.—Eyes quite well. Mouth still tender. To continue the powders.

22nd.—Mouth much better.

Jan. 10.—Now quite well.

A woman, æt. 47. Ptosis on right side. Paralysis of all the other muscles supplied by the third pair.

Pupil in a middle state and sluggish. Vision rather impaired.

Came on two months ago, accompanied by violen pains in the head, and creeping sensation over the eyebrow.

Recovered under cupping, mercurialisation, and counter-irritation. The power over the levator palpebræ began to be recovered soon after the commencement of the treatment, and was complete a considerable time before the patient could freely turn the eye inwards, upwards, or downwards in concert with the opposite eye.

It was three or four months before recovery was perfect.

4th.—*Paralysis of the muscle supplied by the nerve of the fourth pair.*

Paralysis of the superior oblique muscle, as already observed, is not manifested by very evident loss of correspondence in the direction of the two eyes, except on looking downwards, but in consequence of the deviation of parallelism of the vertical and horizontal diameters of the eyeball of the affected side from those of the other eyeball, there is an obliquity in the position of the image seen by the former, so that there results a peculiar form of double vision. This is corrected on leaning the head forward and to the opposite side, the action of the inferior oblique here restoring the parallelism (p. 573, et seq.).

Analysis of the phenomena attending paralysis of the left superior oblique muscle.—The patient directs the axes of the two eyes to the upper half of the field of view properly; but the more he looks downwards, the more his eye lags inwards and upwards. While the affected eye is ill-directed, the sound one deviates inwards and downwards, under a still greater angle. Vertigo thereby comes on, and the patient walks awkwardly if he looks downwards and to the left at objects. In order to prevent double vision when the two eyes are open, he bends his head forwards, and at the same time turns it somewhat to the right. The homonymous double images appear in the lower half of the field, and increase in respect to difference in height, the further downwards the object is placed. The image of the left eye is inclined obliquely towards the right. If the look is inclined downwards to a certain degree, and if we move, during this inclination of the visual plane, the object in it from right to left, the difference in respect to height of the double images diminishes, while the obliquity on the other hand increases, attains its maximum when the visual axis is directed outwards about thirty-five degrees (that is, therefore, coincides with the rotation-axis of the oblique muscles).

As the action of the obliqui, on the turning of the cornea downwards, increases in proportion as the visual axis approaches the plane of the muscles (*i.e.*, the more it s turned inwards), so must also the defective action of a eft oblique muscle be marked on looking towards the right; and, for the same reason, the line which separates the field of single vision from that of double does not run horizontally, but rises obliquely towards the right. From this is explained the above-mentioned symptom, which, n general, strikes us on first looking at a patient affected with paralysis of the superior oblique muscle, viz., that with the forward inclination of the head is combined an nclination to the sound side; as with paralysis of the left superior oblique, the field of single vision has the greatest extent towards the left.

In paralysis of the superior oblique, objects appear nearer to the affected eye than to the sound one. This, sometimes, also occurs in other affections, but never so strikingly as in paralysis of the superior oblique, in which it becomes more evident the further the eye is moved towards the right.

The four recti muscles acting together draw the eyeball back into the orbit, while the two oblique muscles are antagonists to them in this respect. Hence, while in paralysis of several of the recti, *paralytic exophthalmus* occurs; in paralysis of the superior oblique the eye will be retracted deeper in the orbit.

5th.—*Paralysis of the muscle supplied by the nerve of the sixth pair.*

Paralysis of the muscle supplied by the nerve of the sixth pair, or the external rectus, is of rarer occurrence than that of the muscles supplied by the nerve of the third pair.

In this affection the eye is inclined towards the nose, and cannot be turned out (*convergent luscitas*); and, of course, in consequence of non-correspondence of the tw eyes there is double vision, which is in this case more fe as the eye continues open.

Analysis of the phenomena attending paralysis of the external rectus of the left eye.—In paralysis of the left abducens muscle, both visual axes are directed to the right The further, however, the look is turned to the left, th more does the defective action of the muscle appear, b misdirection of the visual axis inwards. If we move th object in a horizontal direction from right to left, it wil continue to be fixed to about as far as the middle line from thence the visual axis is misdirected inwards, and that so much the more the further we go to the left. I we make the same movement when the visual plane is directed somewhat upwards, the misdirection takes place later; when directed somewhat downwards, it takes place sooner.

This is owing to the law, that on inclination of the visual plane downwards, there is a tendency to convergence; on elevation of the visual plane upwards, there is a tendency to divergence.

Pathological divergence is, therefore, more manifest when looking upwards; pathological convergence, on looking downwards.

On closing the sound eye, an object, still somewhat above the middle line, moved from right to left, may be fixed towards the left. It might, *à priori*, be supposed that the two obliqui must combine in a vicarious action on the failure of the activity of the abducens, inasmuch as they counterbalance each other in respect to their action upwards and downwards, and to the inclination of the vertical meridian, and so move the cornea in the horizontal direction outwards to about 35°. This action, which, so far as regards the position of the muscles, is possible, does not in fact occur. On the contrary, when the abducens is completely paralysed, those two muscles move the globe at most only 15° outwards; and this takes place, not by a single equable traction, but the cornea moves by jerks, now following one muscle, now the other, in a zig-zag way.

If we observe what the sound eye, which we have covered with the hand, is meanwhile doing, we find that it is misdirected inwards of the object, and that—which is a point of great importance for the diagnosis—under an angle which is greater than that under which the affected ye was previously misdirected during the action of the ound one. This symptom presents itself in all cases of aralysis of the muscles of the eye, and is so far chaacteristic of them that it indicates how a very strong imulse of the will which is called up, in order to bring bout, by an effort, a certain position of the eye, calls orth in the other eye, which is normally innervated, an xcessive effect by a very strong associated movement.

The small effect which is brought forth towards the ide of the paralysed muscle by a strong impulse of the vill, at the same time calls forth another symptom; the atient, namely, projects his whole field of vision too far owards that side towards which the paralysed muscle hould turn the eye, and towards which he thinks he has urned it, in accordance with his intention. Greater ertigo thus comes on. When the left abducens is paraysed, the patient passes to the left side of the objects e wishes to avoid.

On opening both eyes, this vertigo usually does not ccur. The diplopy is the only disturbance. In order to orrect this, the patient turns the head to the left, as he hen sees all objects in the right half of the field of view, n which he can unite the two visual axes.

To test the double images more minutely:—If we move n object in the horizontal visual plane from right to left, t is seen single to about as far as the middle line. From hence towards the left it appears double. The double mages are homonymous, *i.e.*, the left belongs to the left ye, the right to the right eye. They stand parallel to ach other equally high, and separate further from each ther the more the object is to the left. If we test, in he same way, the position of the two images when the isual plane is inclined upwards and downwards, we find hat, in the first case, the double images appear further o the left, and, in the second case, further to the right; hat, therefore, those halves of the field of view, in which ision is single, are not separated from those in which ision is double by a vertical line, but by a line obliquely nclined towards the left.

In order to correct the double vision by a prism, we nust, as in all cases of pathological convergence, hold it vith the base outwards before the affected eye; as, in his way, the rays of light from the object looked at, vhich would arrive at a part of the retina situated on the inside of the macula lutea, are diverted by the prism towards its base, and thus directed further outwards. They are therefore, the strength of the prism being suitable thrown exactly on the centre of the retina.

Causes.—What has been said of paralysis of the parts supplied by the nerve of the third pair, is applicable to paralysis of the external rectus. In one of the following cases it appears to have been occasioned by a blow on the temple.

Prognosis.—This palsy is more tedious of cure than that of the muscles supplied by the third pair.

Treatment.—This is illustrated by the two following cases:—

A woman, æt. 41, received a blow with a fist on the left temple, close to the outer corner of the eye. The skin was broken, and bleeding took place at the time, and by-and-by the eyelids became swollen and livid.

The sight was not at first affected, but about three weeks afterwards everything suddenly appeared to the patient confused.

Shortly after this, when the patient applied for advice, the immediate effects of the blow had disappeared, except some slight conjunctival ecchymosis next the outer angle.

On examination it was observed that the left eye was more prominent than the right, and that it could not be turned towards the left in concert with the right eye. The patient, therefore, saw double; she was quite able to turn the left eye towards the right in concert with the right eye; in this case vision was single.

After the blow, suffered from headache, which ceased after the defect of sight supervened.

The treatment, which consisted in cupping once to about ℥viij., mercurialisation, repeated blistering, and latterly quinine, was continued for about two months before any manifestation of improvement. She was then able to turn the eye towards the outer corner to some extent.

In another fortnight she was able to turn the left eye almost perfectly towards the outer corner, and was no longer disturbed with double vision.

A man, æt. 36, labouring under diplopia. When a finger is held before him he sees two images side by side. If the finger be held to the left, the images approximate until they coalesce, and one only is seen. If the finger be held to the right, on the contrary, the two images are seen wider apart.

It is the right eye which is at fault; the external rectus being paralysed so that he cannot turn it towards the temple. Suffered pain over both eyebrows yesterday. Had gonorrhœa about three months ago.

The patient was cupped on the right temple to ℥viij., when first seen, and again a fortnight after. He took calomel and opium to the extent of affecting his mouth and keeping it so for three or four weeks. Had an occasional laxative, and was repeatedly blistered.

Under this treatment he began, in the course of three weeks, to improve, gradually gaining more and more the power to turn the eye towards the temple, whilst double vision became proportionally less, until, at last, in the course of a few weeks more, he was able to move the right eye in perfect concert with the left, and double vision wholly ceased.

6th.—*Prismatic glasses as a means of promoting the recovery of paralysed muscles.*

When, by appropriate medical treatment, the paralysis begins to subside, recovery may be promoted by exercising the muscle. For this purpose, it has been recommended to place before the affected eye a prismatic glass, with its base on that side towards which the eye should be directed. The image on the retina of the affected eye is thus brought to correspond so nearly with the image on the retina of the sound eye, that the diplopy becomes annoying, and efforts are instinctively made to bring the relaxed muscle into play in order to correct it. The parts of the two retinæ on which the impressions are made being so nearly corresponding, no great exertion of the affected muscles is required to establish a coalescence of the two images.

After a perseverance in this exercise of the affected muscle for a week or so, a weaker prism is to be used, and so on until the muscle recovers its full power and the correspondence in the movements and sensations of the two eyes is re-established.

In the two cases above related, this took place of itself without the help of prismatic glasses.

LOSS OF CORRESPONDENCE IN THE DIRECTION AND MOVEMENTS OF THE TWO EYES.

1st.—*Apparent Strabismus.*

The visual axes or lines—the lines, namely, which extend from the central spot of the retina through the optical centre of the eye—are parallel when a distant object is looked at; if not parallel, there must be squint. In some cases, however, as pointed out by Dr. Donders, there is an *appearance* of squint, though the visual lines are really parallel, owing to the circumstance that the *axes of the corneæ* are not in normal relation with the *visual lines.*

In emmetropic eyes, the visual line always cuts the cornea on the nasal side of its axis,—hence, when the visual lines are parallel, as in viewing distant objects, the axes of the corneæ diverge somewhat.

In hypermetropic eyes the axes of the corneæ diverge from the visual lines much more than in emmetropic eyes, so that in looking at distant objects the hypermetropic person *appears as if squinting outwards.*

In myopic eyes, on the contrary, the visual line sometimes cuts the cornea on the temporal side of its axis, though at a very small angle. In such a case, there is *an appearance of convergent squint*, when the visual lines are parallel in looking at distant objects.

The conditions on which this apparent strabismus depends, it will be seen, play an important part in the production of real strabismus.

2nd.—*Strabismus, or squinting, and luscitas, or immovable distortion of the eyeballs.*

Strabismus and luscitas are equally characterized by loss of the natural correspondence of the optic axes or lines; but in the former, this is owing to want of harmony in the movements of the eyes, not to loss of motive power, for the squinting eye becomes straight and capable of being directed to any object when the other eye is closed; whilst in the latter it is owing to one eye being fixed more or less immovably in one direction, in consequence either of paralysis of the muscle moving the eyeball in the opposite direction, or of organic contraction and adhesion of the muscle, &c., of the side to which the eyeball is turned.

The following are the principal forms of strabismus:—

1, *Strabismus convergens*; 2, *strabismus divergens*; 3, *strabismus sursumvergens*; 4, *strabismus deorsumvergens*.

Of these different forms, by far the most frequent is *strabismus convergens*.

Strabismus divergens, though rare, is next in frequency.

Strabismus sursumvergens and *strabismus deorsumvergens* are very rare.

It is to be remarked that the affected eye is not always turned exactly inwards, outwards, upwards, or downwards, but may be inclined in the intermediate directions; sometimes in a state betwixt strabismus sursumvergens and strabismus convergens, and sometimes betwixt strabismus sursumvergens and strabismus divergens.

3rd.—*Strabismus convergens.*

Objective characters.—In *simple convergent strabismus*, the pupil of one eye is habitually more or less turned towards the nasal canthus, whilst the other eye looks straight forward, and is capable of being directed to the various objects on which the person fixes his regard. It is only when the habitually well-directed eye is closed, that the inverted eye becomes straight and falls under the command of the patient to be turned in any direction; but as soon as the former eye is again opened, the person loses all command over the other, and it falls back into its original state of inversion.

When the habitually well-directed eye is covered it squints, while the previously squinting eye becomes properly directed; though it, perhaps, resumes its straight direction tardily and with apparent difficulty.

In *alternating convergent strabismus*, the patient has sometimes the power voluntarily to direct either eye properly; but while this is done, the other falls into the state of inversion.

In other cases the habitually squinting eye becomes straight, and the opposite eye squints without the will of the patient.

In regard to the relative frequency with which the right or the left eye is turned in, it appears that the left eye is rather more prone to be so than the right.

Subjective Symptoms.—An early symptom is double vision, though of this the patient does not continue long sensible. It is, however, always found, that if the *vision of both eyes is tolerably good*, and the *attention is fairly fixed on their sensations*, single objects held directly before the face are seen double.

The double vision usually attending strabismus is owing to the circumstance that non-corresponding parts of the two retinæ are impressed by the rays of light proceeding from the same object (p. 577).

The image seen by the properly directed eye appears clearer than the other. This is owing not only to that eye being the stronger, but especially to the circumstances, that in it the impression is made on the central part of the retina, which is more sensible than any other: and that its adjustment corresponds with the distance of the object looked at (p. 577).

The impression on the retina of the squinting eye being on the nasal side, the second image appears projected out towards the temple, *i. e.*, on the right side, supposing the affected eye to be the right. The diplopia is thus *homonymous*.

The image of the affected eye is clearer, and, in consequence, the diplopy more striking the less the *cast* of the eye; hence the double vision may be noticed by the patient before the misdirection of the eye attracts the attention of those about him. When the squint becomes greater, double vision ceases in many cases, because the impression on the sound eye is much more vivid than that on the distorted one; and we know by experiment, that of impressions dissimilar in force on the two eyes, the mind perceives the stronger, to the exclusion of the weaker.

Causes.—The remote causes to which strabismus has, in different cases, been attributed, are very various. They are such as the following: Convulsions during infancy; difficult dentition; hooping-cough; measles; small-pox; worms; injuries and diseases of the head: fright; anger; injuries, inflammation, and other diseases of the eyes, such as opacities of the cornea; and a habit of misdirecting the eyes, whether from imitation, or trying to look at objects too near the eyes or otherwise disadvantageously placed. The rolling of the eyes inwards in photophobia. In many cases, again, no cause at all has been assigned.

Is defective vision of one eye a cause of strabismus?—In most cases the vision of the squinting eye is imperfect; but, it may be asked, is this cause or effect, or are not the defective vision and strabismus both effects of one and the same cause?

As both eyes have a tendency, the one to turn in, while the other remains straight, imperfect vision of one eye will operate as a cause of rendering the squint habitual in that eye, for the reason that, as one eye only can be directed straight at one time, it is naturally the stronger eye which is so. In this case it is to be remarked, however, that the imperfect vision is not the cause of the squint itself; it is merely the cause of determining it to one eye rather than to the other. The justness of this view is illustrated by the fact, that by binding up the stronger eye, and strengthening the weaker by exercise, the strabismus will sometimes shift from the latter to the former.

Supposing defective vision of one eye had some causal connexion with the origin of strabismus itself, it could scarcely be the efficient cause, as much more frequently all degrees of defective vision of one eye exist without the occurrence of strabismus; and blind eyes are not more prone to squint than sound ones.

Convergent strabismus not unfrequently affects several members of the same family, and has therefore appeared to be in some measure hereditary. But as Dr. Donders remarks, it is hereditary only inasmuch as hypermetropia, on which it so often depends, is hereditary.

Hypermetropia the cause of strabismus convergens.—In a very large proportion of cases of convergent squint, Dr. Donders has found the eyes of the hypermetropic conformation. Convergent squint, without hypermetropia, he has, indeed, found the exception. In this state of vision, therefore, he considers that convergent squint in general has its origin.

How does hypermetropia cause convergent squint? In looking at near objects, the hypermetropic person, we have seen, (p. 485), has to converge his eyes very much in order to bring sufficiently into action the necessary amount of near adjustment. Convergent squint comes to be the result of this excessive convergence, under the following co-operating conditions:—

1st. Defective sight of one eye, so that the instinctive effort at binocular vision ceases to be exerted, and the better eye only is used.

2nd. The form of the eyeball and orbit and the excessive power or congenital shrunken state of the interna rectus, whereby the inversion of the cornea is promoted.

Most commonly convergent strabismus has its origin in early life, beginning about five or seven years of age, when the eyes come to be tried. The hypermetropia on which it depends is congenital, but is not in the highest degree, being as yet only latent, that is, made evident only when the far adjusting apparatus is excited to action by atropia. The near adjusting power is still great enough to correct the hypermetropia.

At the commencement of the affection later in life, the misdirection of the eye takes place only when attempts are made to fix an object with the sight. The squint is thus transient or periodical. Diplopia no doubt occurs, but it is rarely complained of, probably because the patient is too young to notice it.

The reason why convergent squint does not occur in every case of hypermetropia given by Dr. Donders is, that the natural tendency of the visual lines instinctively to meet at the object for the purposes of binocular vision, preserves the eyes from the supervention of convergent squint. Defective sight of one eye, however, by interfering with binocular vision obviates this natural tendency, and so leads to disuse of the affected eye.

It is not in the highest degrees of hypermetropia that convergent strabismus is most frequent, but often only in the latent degree, at least in young persons.

Convergent squint occurs chiefly in moderate degrees of hypermetropia—facultative and relative. The eyes in such moderate degrees, can adjust themselves for parallel and even for diverging rays, and can, moreover, maintain this adjustment for some time, though often only along with convergence of the visual lines to a point situated nearer the eyes than that whence the rays emanate.

Proximate cause.—There can be no doubt that the proximate cause of convergent strabismus consists in some affection of the muscles of the eyeball; and the phenomena of strabismus in general, all point to the muscular affection being owing to perverted nervous action.

In strabismus convergens, is it the action of the adductor or abductor which is at fault? If the adductor, it must be in a state of tonic spasmodic contraction, with this peculiarity, that the spasm goes off when the other eye is closed, and immediately returns when it is again opened; and with this further peculiarity, that on closing the previously well-directed eye the spasm comes on in it at the same time that it goes off in the habitually squinting one.

Is it the abductor which is at fault? The abductor is certainly not paralyzed, for on closing the habitually straight eye, it evidently exerts its proper function, though often with defective energy; but, as soon as the latter is again opened, the abductor is no longer able to support the eye in its natural direction, so that the distortion immediately returns. If the abductor be in fault it is obvious that the fault, whatever it is, is transferable from the muscle of the one eye to that of the other.

It has been inferred from the eye not turning out to the external canthus, on section of the internal rectus muscle, that the external rectus was paralyzed, but it appears that the action of the inner fibres of the upper and lower recti, which are advantageously inserted for the purpose, are in general sufficient to restrain the everting action of the external rectus (p. 573, 2nd).

Organic change of the internal rectus does, however, supervene; such as an hypertrophied state of the muscle, as appears from *post-mortem* examination, but especially from observations made during the operation of dividing the muscle at fault. The strabismus thus merges into luscitas.

It is thus seen that there are two distinct sets of cases of convergent misdirection of the eyes, *viz.*, strabismus and luscitas, and that in the former there is in general nothing abnormal perceptible about the organic constitution of the muscles at fault, whilst in the latter there is somewhere organic contraction. But, between cases which may be called pure convergent strabismus and cases of luscitas, there are gradations in which the patient still has more or less power to turn the eye out.

Treatment.—It is scarcely necessary to say, that whatever prompts to a habit of misdirecting the eyes, whether imitation, trying to look at objects too near the eyes, or otherwise disadvantageously placed, careless employment of the sight, and the like, must be carefully guarded against.

When convergent strabismus is of recent origin, and the affection of the muscles is still purely dynamic, suitable convex glasses to correct the hypermetropia should be worn, if the patient be old enough. If not, the habitually straight eye should be kept under the influence of atropia, in order to throw it out of adjustment, and thus to force the other into use and a straight direction.

Exercise of the habitually misdirected eye during two or three hours daily, by covering the other eye, has often been found successful in curing squint. But it is apt to happen that whilst the habitually misdirected eye becomes straight, the previously well-directed one turns in.

When strabismus convergens has become fully established, it resists, as is well known, all treatment such as that above indicated.

4th.—*Section of the internal rectus as a means of cure.*

Ocular myotomy appears to have been practised by the celebrated itinerant oculist the Chevalier Taylor, as a means of curing strabismus more than a hundred years ago; but it never came into use as a regular surgical operation, and so was forgotten.

Of late years, however, it has been revived. Suggested by several different persons independently, and tried on the dead body by Stromeyer especially, the operation on the living body was first introduced into actual practice by Dieffenbach.

It has been seen that in pure strabismus there is in general nothing abnormal perceptible about the organic constitution of the muscle at fault, whilst in luscitas there is either paralysis or organic contraction. Such being the case, the attempt to remedy organic luscitas by operation, every one must admit, was justified by analogy with club-foot; but certainly the same cannot be said for the operation in pure strabismus. It must be confessed, however, that the operation in cases of pure strabismus has proved more successful than could *à priori* have been expected.

Section of the internal rectus of the habitually misdirected eye alone may be sufficient, but section of the internal rectus of both eyes is generally necessary, as it is found that, if one eye only is operated on, it either still remains inverted, or, if it is rendered straight, the previously well-directed eye is apt to turn in.

The latter circumstance is analogous to that above pointed out, viz., that when the previously well-directed eye is covered, and the habitually inverted one, by being thus called into exercise becomes straight, the former turns in.

In double convergent strabismus both internal recti should in like manner be divided at the same time.

Position of the patient, assistants, and operator.—This is to be arranged as above indicated for cataract (p. 359, et seq.).

Securing of the eyelids.—For securing the eyelids the wire speculum is a convenient instrument, though its use may be dispensed with, and the eyelids secured as above recommended for cataract (p. 360, et seq.), only that this must be done wholly by the assistants, as both hands of the operator are necessarily engaged. One assistant may take charge of both eyelids if there is not a second at hand. There should, however, be an assistant ready with small pieces of sponge, to wipe away the blood, which sometimes flows after the division of the conjunctiva, and collects in the wound.

Section of the internal rectus.—The opposite eye being covered, the patient is to be directed to turn the eye to be operated on as much outwards as he can. Whilst he does this, the surgeon with a toothed forceps held in his left hand, seizes the conjunctiva on the nasal side, and raises it up in a large oblique fold, which he immediately divides with a pair of straight blunt-pointed scissors, so as to make a free incision through the conjunctiva, extending obliquely from the margin of the semilunar fold, a little above the level of the lower margin of the cornea upwards and outwards, to near the upper and inner part of the margin of the cornea, thus:—

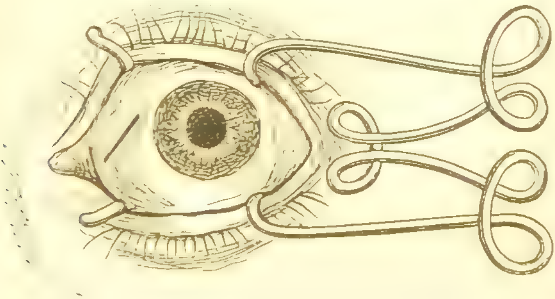

FIG. 143.

Besides the conjunctiva, the sub-conjunctival cellular tissue and fascia must be also freely cut through. The whole length of the incision ought not to exceed one-fourth or one-third of an inch. By this division of the conjunctiva, subconjunctival cellular tissue, and fascia, the tendon of the internal rectus, which is inserted into the sclerotica at about one-fifth of an inch from the margin of the cornea, is exposed. Seizing the cut edge of the conjunctiva next the semilunar fold with the forceps, the surgeon should now pass the scissors inwards behind the conjunctiva and semilunar fold, and divide the cellular tissue intervening between them and the muscle.

The next step is to pass a blunt hook (Fig. 144) behind the tendon, between it and the sclerotica, from below upwards; bringing its point, when fairly passed behind the tendon, out through the incision of the conjunctiva, by depressing its handle.

The tendon of the muscle being thus raised, the next step is its section, which is effected with the scissors, on the nasal side of the hook.

After this is done, an exploration of the bottom of the wound is to be made with the hook, in order that any fibres of tendon or bands of cellular tissue remaining uncut may be raised and divided.

What is called the subconjunctival operation is performed by making the incision of the conjunctiva and subjacent fascia over the lower border of the tendon of the internal rectus, and having hooked the tendon, dividing it with small snips of the scissors behind the conjunctiva.

The effect of division of the internal rectus of one eye in convergent strabismus, may be, that the axis of the eye becomes directed straight forward, and can be preserved so, though the other eye is kept

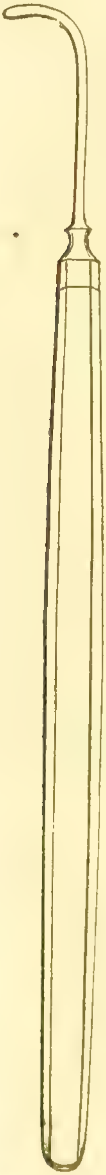

FIG. 144.

open. If, however, this should not be the case, but the eye still remains inverted, division of the internal rectus of the opposite eye should be forthwith performed.

After the operation, the eyes ought to appear to diverge somewhat; as in hypermetropia, it is only in this position of the axes of the cornea that the visual lines have a parallel direction.

That the visual lines of the two eyes do not always correspond immediately after the section, is shown by the circumstance that double vision has been in most instances an immediate result of the operation, but it has usually gone off sooner or later.

The reason of double vision occurring after, when perhaps it did not exist before, the operation, when the axes of the eyes, deviated so much more, appears to be this:—the rays of light from the object regarded by the sound eye, were either not at all received on the retina of the squinting eye, or if so, received in a place considerably removed from the most sensible part, and the impression on which, therefore, was too weak to fix the attention; whereas, after the operation, the rays striking, in the eye operated on, a part of the retina nearer the centre, the sensation is strong enough to attract notice, but the axes of the two eyes not yet quite corresponding, there is double vision.

It has sometimes been remarked that the vision of the eye became weaker after the operation, but soon improved again. More frequently, considerable improvement in the vision of the eye operated on has been, or has been fancied by the patient to have been, a result of the operation. Generally, however, there is no actual change in the retinal power, and rectification of the squint is all that is gained from the operation.

Unnatural prominence of the eyeball amounting sometimes to semi-dislocation, used to be a common result of the division of the internal rectus, owing to the eye having been too forcibly dragged forwards at the time of the operation.

The depression at the inner corner from the recession of the conjunctiva, semilunar fold, and caruncle, which has sometimes resulted, appears to be owing to the cellular tissue between the semilunar fold and the muscle not having been sufficiently divided, so that the former is drawn back by the retraction of the latter.

Management after the operation.—The patient should be forbidden to look at near objects at all for some time, and when he does so, to use convex glasses. Hypermetropia having had a causal connection with the squint originally, it will be necessary for the patient to use suitable convex glasses for reading with, or otherwise exercising the sight on near objects, if not also for looking at more distant objects.

Eversion of the eye, after section of the internal rectus, by the action of the external rectus has much less frequently happened than might have been anticipated. This is owing, in a great measure, as above said (p. 597), to the inverting action of the inner fibres of the superior and inferior recti.

In cases of eversion, the eye may eventually turn right. If it does not, division of the external rectus must be had recourse to.

5th.—*Strabismus divergens.*

Strabismus in all respects analogous to convergent strabismus, except that the misdirection of the eye is outwards, is rare.

Divergent luscitas from paralysis of the muscles supplied by the third pair, must not be confounded with divergent strabismus.

The eversion which sometimes occurs after section of the internal rectus for convergent strabismus, inasmuch as the eye can still be moved somewhat from the external angle when the other eye is closed, partakes partly of the characters of strabismus and partly of those of luscitas.

The impression on the retina of the squinting eye being on the temporal side, the second image appears projected towards the nose, *i.e.*, to the left side, supposing the affected eye be the right. The diplopia is thus *crossed.*

While convergent strabismus usually occurs in childhood, divergent strabismus most frequently does not come on until a later period of life. This is connected with the later development of the myopia, on which, according to Dr. Donders, the deviation depends.

Myopia the cause of Strabismus divergens.—As convergent strabismus is in a large proportion of cases combined with hypermetropia, so divergent strabismus is often combined with myopia.

Divergent strabismus in myopia is, according to Dr.

Donders who has pointed out the connexion, owing chiefly to the altered form of the eyeball from the posterior sclerotic staphyloma offering a resistance to the due convergence of the eyes in binocular vision. The consequence is, that to avoid the fatigue occasioned by the straining of the internal recti (*asthenopia muscularis*) the person reads with one eye only, whilst the other turns out, constituting *relative divergent strabismus*. At greater distances, the visual lines may be still properly directed and converged. Eventually, however, the eye may turn out even when the patient looks at those greater distances, in which case we have *absolute strabismus divergens*.

The name of divergent strabismus is usually given to the absolute form only. In this sense divergent strabismus is less frequent than convergent strabismus.

Relative divergent strabismus, according to Dr. Donders, may arise, on the one hand, where there is considerable weakness of the internal recti muscles without any myopia, and on the other, in high degrees of myopia without any weakness of those muscles. It occurs, however, in its most important forms when myopia and muscular weakness are combined in a moderate degree. If myopia be absent, the weakness of the internal recti muscles usually produces muscular asthenopia only, and seldom passes into strabismus divergens. If myopia be present, a number of causes combine to give rise to strabismus divergens—at least relative—and by this very means to prevent muscular asthenopia.

Myopia necessitates greater convergence of the visual lines, because the objects are looked at closer to the eyes. Now in myopia, the convergence is for two reasons more difficult:—1st, on account of the impeded movement, and 2nd, on account of the altered direction of the visual lines. That relative divergent strabismus occurs preferentially in myopia, follows from these facts as a matter of course.

Section of the external recti has not been so successful in divergent as section of the internal recti in convergent strabismus. The return of the eye from its state of eversion to a straight direction after section of the external rectus is but very gradual.

Division of the corresponding recti of both eyes at the same time is equally applicable to divergent as to convergent strabismus.

6th.—*Section of the external rectus.*

This is performed in essentially the same manner a that of the internal rectus, it being remembered that th insertion of the tendon of the external rectus is as much as a quarter of an inch from the margin of the cornea and is thinner than that of the internal.

7th.—*Strabismus sursumvergens and strabismus deorsumvergens.*

The turning up and turning down of the eyes, comprehended under these names, appear to be rather examples of luscitas, than pure strabismus.

Cases have been met with, in which the eye having been previously directed inwards and upwards, turned right upwards, after the section of the internal rectus, and was brought back to a natural position only by section of the superior rectus.

In reference to section of the superior rectus, it is to be remembered that the insertion of its inner fibres is nearer the margin of the cornea, but that the average distance of the insertion from the margin of the cornea is about a quarter of an inch.

The insertion of the inferior rectus is similar to that of the superior, but not quite so far from the margin of the cornea, being only about one-fifth of an inch. Section of the inferior rectus does not seem ever to be required.

8th.—*Treatment after the operation of ocular myotomy.*

In general, little treatment is required. It is always advisable that the patient should be kept at rest for a day or two after the operation. A cold lotion may be applied to the eye but, if pain come on, warm fomentations will be better.

The accidents which have occurred during and after the operation, are:—The eyeball cut into and the vitreous humour evacuated. Hæmorrhage to a dangerous extent. Inflammation of the conjunctiva with chemosis. Inflammation in the orbit, ending in abscess. Panophthalmitis ending in total destruction of the eye. Convulsive movements of the eyeball. Many of these accidents, however, there can be no doubt have been owing to a rude performance of the operation.

When a return of the strabismus takes place, the operation may be repeated. Sometimes success has been obtained only after a second or third repetition.

9th.—*Oscillation and nystagmus of the eyeballs.*

Oscillation of the eyeball is a to-and-fro movement of it round its antero-posterior axis, whilst nystagmus is a similar movement round its vertical axis. The former appears to be owing to clonic convulsion of the oblique muscles, the latter to clonic convulsion of the internal and external recti.

These irregular movements are most generally met with attendant on defective vision, from whatever cause, which has existed from birth or from an early period of life—such as congenital albinism, congenital cataract, amaurosis—or general nervous complaints, such as hysteria, epilepsy, chorea—or evident disease of the brain.

But little can be done by way of medical treatment. Ocular myotomy, which has been applied to the treatment of so many different affections of the eye, has been applied to the cases under consideration also, and it is said with success.

AFFECTIONS OF THE NERVE OF THE FIFTH PAIR.

1st.—*Neuralgia of the ocular and orbital branches of the fifth nerve.**

Supraorbital, circumorbital, temporal, and hemicranial pain, which so often accompanies the internal inflammations of the eye, are to be distinguished, as above observed, p. 62, from idiopathic neuralgia of the branches of the ophthalmic division of the fifth nerve. In neuralgia, there may be some vascular congestion of the part affected, but it intermits with the paroxysm.

Neuralgia of the nerve of the fifth pair is the most common of all the neuralgiæ.

It occurs in paroxysms.

Sometimes it is of aguish origin, the paroxysms following a quotidian, tertian, or quartan type.

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* Prosopalgia, or faceache.—Tic douloureux.

Sometimes it appears to arise from a chill, from decayed teeth, from a wound on the eyebrow, &c. In such cases the paroxysms may occur at irregular intervals.

The paroxysms come on spontaneously, or from some very slight cause; sometimes suddenly, sometimes gradually; sometimes they are of short duration, sometimes persisting for hours, though remitting in intensity. The skin of the face is sometimes pale, sometimes red; sometimes dry, sometimes the seat of perspiration. There may be some degree of impairment of the sensibility of the part to external impressions.

Treatment.—Belladonna, quinine, and carbonate of iron internally, and the subcutaneous injection of a solution of morphia locally, are the remedies which have been most efficacious in giving relief.

Of course any obvious source of irritation which may exist, such as decayed teeth, a cicatrice involving a branch of the fifth nerve, &c., ought to be removed.

2nd.—*Affection of the eye from disease of the nerve of the fifth pair.*

In disease implicating the root of the nerve of the fifth pair, there may be neuralgia in and around the eye, accompanied, perhaps, by impaired or lost sensibility of the skin, conjunctiva, and cornea to external impressions, and by paralysis of the muscles of mastication, supplied by the motor division of the nerve.

Paralysis of muscles supplied by the facial sixth, and third nerve may also coexist.

In such a case inflammation of the eye is liable to supervene, characterised by a tendency to ulceration of the cornea.

The organs of taste, smell, and hearing may also suffer.

I was consulted about the right eye of a gentleman, which had become inflamed four days before. On examination, I found both conjunctival and sclerotic vascularity, and in the middle of the cornea a white sloughy ulcer surrounded by opacity. Elsewhere the cornea was not affected, except that it did not appear quite smooth. The pupil was active, though the iris appeared slightly discoloured.

Opacity of the cornea presented itself the day after the inflammation came on, and the ulceration broke out the day before I saw the patient.

For some months before, the patient had been suffering nocturnal paroxysms of pain all over the right side of the head and face with numbness, and paralysis of the muscles of mastication of the same side.

These symptoms underwent no change on the occurrence of the attack of inflammation in the eye, nor since.

The patient has been suffering also from pain and noises in the right ear.

I saw the patient again a month after. He seemed to be suffering still more from the pains, with numbness in the right side of his head and face, and his mouth on the right side hung open and relaxed, with the saliva flowing out. The inflammation of the eye was increased. In the middle of the ulcer there was a small brownish slough or scab; around this a ring of dead white substance, and externally a grayish opacity. Hypopyon had now formed.

I evacuated the aqueous humour with some advantage. The patient did not feel the puncture. In performing the operation, I found the cornea more yielding, perhaps, than natural.

The symptoms in this case resemble very much the effects produced by section of the fifth nerve, close to its escape from the pons, in Magendie's experiment.

But cases occur in which the eye is much more severely affected, and the cornea becomes rapidly destroyed; in this respect resembling the effects observed by Magendie when in dogs, he divided the nerve where it lies on the petrous bone.

There was loss of common sensation in and about the eye. The vapour of ammonia no longer excited lacrymation or winking. The pupil was contracted and immoveable. The eye became inflamed, with a white puriform discharge. Opacity of the cornea supervened; but before this, iritis was observed to have taken place, with exudation of lymph into the anterior chamber. On the eighth day after section of the nerve, the cornea sloughed away, the humours were evacuated, and the eyeball became collapsed.

The difference in the result observed from section of the fifth nerve close to its escape from the pons, and from section of it where it lies on the petrous bone, has been supposed to be owing to the sympathetic fibres which join the fifth being divided in the latter case and not in the former. This supposition has, however, been rendered doubtful by other experiments and pathological observations.

Treatment.—That local treatment which the particular form of inflammation and ulceration would under other circumstances appear to indicate is to be adopted. The general treatment must be that which is appropriate to the intracranial disease. The prognosis is, however, unfavourable.

CHAPTER VII.

DISEASES OF THE EYELIDS.

SECTION I.—INFLAMMATIONS AND ULCERATIONS OF THE EYELIDS.

1st.—*Phlegmonous inflammation of the eyelids.*

IN this inflammation, which more frequently affects the upper than the lower eyelid, the cardinal symptoms, redness, swelling, heat, and pain, are well marked.

The swelling is circumscribed by the border of the eyelid on the one hand, and the margin of the orbit on the other, and may be so considerable as to prevent the eye from being opened.

If resolution does not soon take place, the inflammation goes on to suppuration.

Causes.—Phlegmonous inflammation of the eyelids is frequently of traumatic origin; but in children, in whom it is most common, the cause is sometimes not very evident.

Prognosis and treatment.—If left to itself, the abscess usually points and bursts externally; generally at the margin of the eyelid, near the outer corner. When the abscess is thus left to burst, the skin and cellular tissue of the eyelids are liable to be materially injured, the eventual consequence of which will be distortion of the eyelids of various kinds, shortening, eversion, &c., from the irregular cicatrices.

The treatment best calculated to put a stop to the inflammation, and to prevent injury of the skin and cellular tissue of the eyelid, is a free incision with a lancet transversely through the middle of the swelling. In the purely inflammatory stage, this gives issue to a considerable quantity of blood and fluid exuded into the cellular tissue, relieves tension, and promotes resolution; in the stage of suppuration, it evacuates the matter, and this is usually followed by a subsidence of the symptoms. After the incision, warm fomentations are applied.

The patient is at the same time to be purged and kept at rest.

If the patient dreads the incision, leeches may be substituted in the purely inflammatory stage; and in the stage of suppuration, pointing and bursting of the abscess are to be promoted by warm cataplasms.

2nd.—*Erysipelatous inflammation of the eyelids.*

In erysipelas, the redness varies from a pale rose-tint inclining to yellow to a bright scarlet or livid hue, is not circumscribed, and disappears on pressure, but soon returns.

The swelling is not great but diffused. Where, however, there is loose subcutaneous cellular tissue as in the eyelids, there is, in addition, considerable œdematous swelling from copious serous exudation into it.

The pain, which is superficial, and generally not severe, is of a burning character.

Constitutional symptoms.—For some days before, the patient complains of general uneasiness, headache, loss of appetite, nausea, and perhaps vomiting; all of which symptoms cease or are much relieved when the erysipelas makes its appearance.

In erysipelas of the face the eyelids are always involved, but sometimes they are the original seat of the inflammation, especially in cases arising from injury.

Besides lacrymation, there is increased Meibomian and conjunctival secretion, which, in the form of a puro-mucous matter, collects over-night along the border of the eyelids, and at the inner canthus.

Erysipelas of the eyelids usually ends in resolution, in which case the redness and swelling subside, and branny scales, consisting of exfoliated epidermis and dried exudation, are thrown off from the surface.

In consequence of serous exudation under the epidermis, vesicles or bullæ are sometimes formed. These by-and-by burst, and, the matter set free becomes dried into crusts, which, with the branny scales, eventually fall off, leaving the skin in a sound state.

In more violent cases, along with severe pain in the part, and constitutional disorder, the inflammation runs on to diffuse suppuration and mortification of the subcutaneous cellular tissue.

The erysipelas extending from the region of the lacrymal sac over the eyelids and cheek, in cases of dacryocystitis is often of this phlegmonoid character. See *infra*.

General treatment.—The best remedy at first is a pill composed of three or four grains of calomel with a grain or two of extract of hyosciamus, followed next morning by an emeto-cathartic, consisting of tartar emetic, and Epsom salt. Whatever other general treatment may be necessary will depend much on the circumstances of the case. The alterative and tonic plan is that which proves most effectual, especially in London. Elsewhere the antiphlogistic plan is usually found the best.

Local treatment.—In many cases, the erysipelas subsides without any local application.

In severer cases, it is advisable to have recourse to scarification by punctures with the point of a lancet, encouraging the bleeding by warm fomentations. This affords great relief even in a few minutes, prevents vesication, and diminishes the risk of suppuration and mortification.

When the inflammation has gone so far that suppuration and mortification are threatened, or if they have already taken place, free transverse incisions should be made through the skin into the subjacent cellular tissue, and warm water dressing applied.

By this practice, mischief is averted, or, if it has already begun, arrested by a free outlet being afforded for pent-up matter, and sloughy cellular tissue.

An outbreak of erysipelas may lead to a favourable termination of a stubborn ophthalmia, as in the following case:—A child of about ten years of age has had, in the course of the last two years, several attacks of phlyctenular ophthalmia. The last has been accompanied by great intolerance of light, and has proved very rebellious to treatment. The eyes could not be examined except while the child was under the influence of chloroform. The cornea of the right eye was the seat of a large vascular ulcer, but the left eye did not appear much inflamed. Paracentesis corneæ was performed on the right eye with small benefit. Some days after this, while the child was again under the influence of chloroform, the skin of the upper eyelids was rubbed with solid nitrate of silver, and, after that, frequent bathing of the eyes with iced water was prescribed.

This treatment was followed by a rather severe outbreak of erysipelas of the face with vesicles, which, however, subsided favourably, and with the cure of the erysipelas recovery of the eyes took place.

3rd.—*Variolous inflammation of the eyelids.*

The variolous eruption on the eyelids has been noticed under the head of variolous ophthalmia (p. 252), with a reference to this place for the treatment calculated to prevent distortion of the eyelids, such as entropium, ectropium, or trichiasis, from bad cicatrices succeeding the pustules.

The plan which is usually recommended for this purpose is to endeavour to check the development of pustules at the edges of the eyelids by touching them in their early stage with lunar caustic; or if the pustules have already formed, by evacuating them by puncture and then applying the caustic.

4th.—*Carbuncle and malignant pustule of the eyelids.*

Carbuncle sometimes occurs in the eyelids, especially the upper.

The danger is the same as when it occurs on other parts of the body, and in consequence of the loss of substance occasioned by the sloughing, ectropium is the usual result, supposing the event of the case otherwise favourable.

The treatment is the same as when the disease occurs on other parts of the body, viz., opium to relieve suffering, wine and nourishing diet to keep up the powers of the system, and a free crucial incision into the swelling, followed by the application of emollient poultices, until the slough separates, when granulation and cicatrization are to be promoted in the usual manner, care being taken to obviate contraction as much as possible.

In the American edition of this work (p. 344), it is here stated that the carbuncle may sometimes be aborted, and, perhaps, always materially abated, in its forming stage, by the application to its summit of the vegetable caustic, in such a manner as to induce a superficial eschar.

Malignant pustule, which is a gangrenous inflammation of the skin and cellular tissue, most frequently produced by contagion from oxen, horses, &c., their carcasses or their hides, not much known in this country, but common on the Continent, sometimes affects the eyelids.

The injury to which the eyelid is exposed from sloughing is the same as in carbuncle, but the constitutional symptoms may be still more severe, and the result is often fatal.

The first point of treatment insisted on by those who have experience of the disease is to destroy the infected part by the actual or potential cautery.

The general and local treatment is in other respects the same as in carbuncle.

5th.—*Ophthalmia tarsi.*

This is a chronic inflammation of the tarsal borders of the eyelids, of which there are two principal forms, viz., *catarrhal* and *scrofulous*.*

The former occurs in adults, and principally affects the delicate integument of the tarsal border and the adjoining conjunctiva and skin of the eyelid;—the latter occurs in children, and affects principally the glandular structures at the borders of the eyelids and the roots of the eyelashes.

6th.—*Catarrhal Ophthalmia tarsi.*†

Objective symptoms.—Towards the borders of the eyelids the skin is somewhat red and swollen, the conjunctiva red and villous, and the delicate integument of the border itself more or less excoriated, especially at the angles—inner as well as outer.

The eyelashes are loaded with Meibomian secretion, and the eyelids become glued together by it over night.

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* These two forms of chronic inflammation of the tarsal borders are generally recognised, but there is great confusion in the names employed to designate them. Some authors employing the name *ophthalmia tarsi* exclusively to the catarrhal form; others, again, exclusively to the scrofulous form, and it is the same in regard to some of their synonymes, such as *lippitudo*, and *psorophthalmy*.

† Chronic catarrhal ophthalmia. Blapharoblenorrhœa senilis. La mitte, or miasmatic ophthalmia of scavengers and nightmen, &c.

Subjective symptoms.—These are itchiness and smarting at the borders and angles of the eyelids, and the sensation of foreign particles in the eye, with some intolerance of light, and lacrymation.

When the complaint has been of long continuance, many of the eyelashes fall out, and some become misdirected, and not unfrequently slight inversion or eversion of the borders of the eyelids takes place—the former generally from transverse shortening of the border of the eyelids, the latter from contraction of the skin and a sarcomatous state of the conjunctiva (*ectropium senile*).

Causes.—The disease, which may be the sequela of a common general catarrhal ophthalmia, or may, from the first, be confined to the tarsus, affects adults chiefly, whose occupation exposes them to cold and damp, to bad air and mephitic vapours, especially if addicted to intemperance in spirituous drinks; or, independent of such conditions, weakly and old persons.

Treatment.—If there be much redness and smarting at the borders of the eyelids, it will be advisable to commence the local treatment by the application of two or three leeches to the part, or scarification of the palpebral conjunctiva, if this be very red and villous, and bathing with tepid water; after that the bichloride of mercury lotion (p. 81) may be prescribed, to be used twice a day, and the weak red precipitate ointment (p. 85) at bedtime; the surgeon himself pencilling the palpebral conjunctiva every second day with the nitrate of silver solution.

If under this treatment the disease does not appear disposed to subside, it will be useful to apply blisters behind the ears, or paint the solution of iodine (p. 88) over the skin of the eyelids.

Though sometimes an opposite plan is necessary, the general treatment requires to be such as is calculated to support the powers of the system, viz., good diet and tonics; but before having recourse to this, the digestive organs must be regulated by the exhibition of a few doses of blue pill followed by purgatives.

Sometimes morbid sensibility, from a sunk state of the system, is so great, that the above-mentioned local remedies cannot at first be borne. In this case the belladonna lotion alone, or combined with lead water (as recommended by the American Editor), should be used, and some mild ointment to the edges of the eyelids, with counter-irritation behind the ears, until such time as by the general treatment just indicated the powers of the system are raised, and the morbid sensibility removed, when the irritating applications may be again had recourse to.

7th.—*Scrofulous ophthalmia tarsi.**

Objective symptoms.—The eyelids are at their borders somewhat red and swollen, and the eyelashes are loaded with incrustations, consisting of the secretion of the Meibomian glands, and of that of the bulbs of the eyelashes, which are poured out in increased quantity, especially over night, so that the eyelids are glued together in the morning.

The palpebral conjunctiva is found, on everting the eyelids, more or less reddened and villous, often granular.

There is occasionally a flow of tears, which fall down over the cheek and cause excoriation of it.

When the incrusted matter is removed from the eyelashes (the manner of doing which is laid down in p. 79), small vesicles, or pustules, or ulcers, left by them, are discovered at the roots of the hairs.

Subjective symptoms.—Of these, great itching at the borders and angles of the eyelids is the most marked; indeed so much so as to have originated the opinion, which, however, is quite unfounded, that the disease is psora or itch of the eyelids, hence the name *psoropthalmy*, which has been given to it. Besides the itching, there is heat and occasional smarting.

In an advanced stage of the disease, the eyelids are much thickened and nodulated at their borders, from hypertrophy of the tarsal cartilage and enlargement of the glandular structures situated there (*tylosis*); the eyelashes are found scanty (many having fallen out and not been reproduced, or succeeded only by dwarfish misdirected ones (*pseudo-cilia*)), and closely surrounded at their roots by the crusts covering the ulcers which are now more extensive.

In old and neglected cases, the tarsal border comes to form one with the conjunctival surface in consequence of its posterior edge, which, in the natural state, forms a well-marked line of demarcation between the two, being rounded off, or obliterated, and acquires, like the conjunctiva, a red and sarcomatous appearance.

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* Psorophthalmy, tinea ciliaris, tinea tarsi, blepharitis scrofulosa, &c.

In such cases, the eyelashes have perhaps all, or mostly all, fallen out (*madarosis*) from destruction of their bulbs; and, as no Meibomian secretion can be pressed out, it would seem that the Meibomian apertures are obliterated also.

Along with this state of the eye, which is called *blear-eye* or *lippitudo*, there may be some degree of eversion from contraction of the excoriated skin of the eyelids.

The subjects of this form of ophthalmia tarsi, who are generally young persons, often present other evidences of the scrofulous constitution, such as disordered digestion, tumid belly, enlargements of the glands of the neck, cutaneous eruptions, sore ears.

Causes.—The disease is seldom primary, but is generally a sequela of some ophthalmia, such as exanthematous, catarrhal, scrofulo-catarrhal, or ophthalmia neonatorum, or it arises from the spread of some cutaneous eruption to the borders of the eyelids.

Impure air, damp, bad diet, want of cleanliness, and the like, at the same time that they cause or keep up the bad state of general health, aggravate the local disease, and, indeed, added to neglect or bad treatment, are the principal causes which render it inveterate.

Prognosis.—Except in cases in which the disease has attained the development above described as lippitudo, the prognosis, though on the whole not unfavourable, must be qualified by this, that the cure is likely to be protracted. The supervention of puberty has in general a beneficial effect on the complaint.

Treatment.—Being frequently connected with a faulty state of the constitution, it is of great consequence that attention should be directed to the general health.

The employment of alteratives and purgatives will be found useful preliminaries. The state of the skin must also be looked to, and antimonials employed if necessary. Afterwards tonics, together with occasional laxatives.

The diet and regimen above recommended in phlyctenular ophthalmia (p. 197), are equally indicated here.

The first point in the local treatment is, that after removing the incrustations from the borders of the eyelids, by means of glycerine, in the manner above directed, to pluck out all those eyelashes at least which are so loose as to yield to the force which can be exerted by means of the finger and thumb grasping them.

This being done as often as is necessary, the disease will, in a great proportion of cases, subside under the use of the bichloride of mercury eye-water (p. 81), three times a day; and the application, in the manner above directed (p. 84), of the weak red precipitate salve (p. 85) to the borders of the eyelids at bed-time.

Mr. Streatfeild insists on the importance of keeping the eyelashes closely cut during the treatment of the case.

If there be much tenderness and irritability, the only local application, at first, should be tepid water to bathe the eyes, and some mild ointment applied to the edges of the eyelids, whenever the incrustations are removed from the eyelashes, until the irritability be relieved, by general treatment, and counter-irritation behind the ears.

Scarification of the congested palpebral conjunctiva is often useful.

In cases in which there is much ulceration at the roots of the eyelashes, it is a good practice, after removing the crusts and plucking out as many of the eyelashes as can be done without subjecting the patient to any great pain, to touch the ulcers with the lunar caustic pencil. This may require to be repeated three or four times at intervals of a few days.

After this the use of the eye-water and salve is to be resumed.

When the disease has become inveterate, any further treatment can only be palliative. It should consist of the occasional use of Janin's ointment (p. 85), and the alum lotion (p. 80); and, when circumstances require it, scarification of the conjunctiva and blisters behind the ears.

If, as is often found in cases of long standing, the palpebral conjunctiva is granular, great benefit is derived from repeatedly scarifying it, and thereafter applying the strong red precipitate ointment or nitrate of silver solution.

When the lower eyelid, and with it the punctum lacrymale, are somewhat everted, stillicidium lacrymarum aggravates the state. Under such circumstances, the lower canalicule should be slit up from the everted punctum lacrymale to the caruncle, in order that the tears may make their way into the lacrymal sac.

8th.—*Hordeolum or stye.*

Stye, as is well known, is a small inflammatory tumou at the edge of the eyelid, attended with more or less hea and pain, and going on to suppuration. It is of a furuncular character. When the abscess bursts, some thick matter, with a small slough, is discharged; the swelling then subsides, and the part heals.

Stye, according to some, is abscess of the Meibomian glands; according to others, it has its seat in the cellular tissue at the margin of the eyelid. Again, it has been suggested that it has its seat in the capsule and glands of the roots of the eyelashes.

Abscess of the Meibomian glands does occur, and gives rise to an external swelling on the edge of the eyelid like a stye, but on everting the eyelid, the affected Meibomian gland is seen distended with matter, which is not the case in stye. There can be no doubt that the roots of the eyelashes are involved in stye, because the hairs at the part affected fall out, and when we pluck them out, matter oozes from the orifice.

As above stated (p. 184), erysipelatous ophthalmia sometimes occurs along with stye.

Causes.—Those most subject to stye are generally of a scrofulous constitution. Derangement of the stomach is a common exciting cause.

Treatment.—At the very commencement, the disease may sometimes be arrested by an emetic, followed by a laxative, and cold applications to the eye, or by touching the inflammatory swelling with caustic. If, however, the disease has already made progress, warm applications to promote suppuration are to be had recourse to. It is in general better to allow the abscess to burst of itself. but when it is mature, and occasions much uneasiness. relief will be obtained from puncturing it.

Dr. Zeis, who is the author of the opinion that the proper seat of stye is the capsule and glands of the roots of the eyelashes, recommends plucking out the eyelashes at once at the part affected. By this practice. the disease is arrested or much mitigated. As the eyelashes fall out at any rate, there can be no objection on the score of saving the eyelashes; besides, they are speedily reproduced.

To prevent the recurrence of the disease, attention must of course be directed to that state of general health and those occasional influences on which it appears to depend.

9th.—*Inflammation and abscess of the Meibomian glands.*

Inflammation and abscess of the Meibomian glands simulate, as already said, the appearance of stye externally; but the disease is of rarer occurrence, and its nature is recognised on everting the eyelid, when the affected gland or glands are seen, through the conjunciva, turgid with yellow matter, which, perhaps, may be made by pressure to ooze out of the corresponding apertures at the border of the eyelid.

By a touch with the point of the lancet, the turgid gland is opened and the matter evacuated.

10th.—*Syphilitic affections of the eyelids.*

Syphilitic ulceration, sometimes primary, more commonly secondary, sometimes affects the eyelids either at heir border, or on their external or internal surface; in the one case, going on to destroy the whole thickness of he lid, in the other case producing a deep and foul excavation.

As syphilitic ulceration goes on in spite of ordinary local applications, it is of importance to distinguish the nature of the case, in order that by the timely employment of reatment for the constitutional affection, the progress of the ulceration may be arrested.

This having taken place, the next point in the treatment is, so to direct the cicatrization, that deformity of he eyelid may be as far as possible prevented.

A man, æt. 28. Admitted Aug. 30. Contracted syphilis four years ago, for which he was treated and dismissed as cured seven months since.

About three weeks ago a small painful swelling formed on the lower eyelid (right side) towards the inner corner.

At present there is ulceration all along the edge of the ower eyelid where the eyelashes are implanted. The upper eyelid is not ulcerated, but both it and the lower are very œdematous and red. The conjunctiva of both eyelids is very red and much thickened,—that of the ower eyelid especially so. There is some serous effusion under the ocular conjunctiva at the lower part.

To take iodide of potassium (gr. iij.) in decoction of sarsaparilla.

Sept. 2nd.—Œdema of the lower eyelid gone, that the upper eyelid less. Ulceration of the lower eyeli much the same.

To continue the iodide. Solution of the nitrate of silve gr. iv.—℥j. dropped into the eye. The red precipita ointment (gr. iij.—ʒj.) to be applied to the ulcerated edg of the eyelid at bed-time.

4th.—The ulceration along the edge of the lower eyelid has begun to cicatrize. Œdema of the tarsal edge o upper eyelid continues. Repeated the nitrate of silve drops. To continue the iodide.

9th.—Cicatrization all along the edge of the lower eyelid almost complete. Conjunctiva of lower eyelid stil red and spongy-looking. Still some œdema of upper eyelid. To continue the iodide and sarsaparilla.

21st.—Has not been here since last report, and ha therefore had no medicine for some days.

The lower eyelid is now quite healed. The upper eyelid is still œdematous, and on examining its conjunctival surface, there is seen a large ulcerated spot, covered with yellow puro-lymph. Applied the nitrate of silver solution to this. To continue the mixture.

28th.—The ulcer on the conjunctiva of the upper eyelid much less. Repeated the application of the nitrate of silver solution. To continue the mixture.

Nov. 4th.—The ulcer on the inner surface of the upper eyelid has almost disappeared. To continue the iodide and sarsaparilla.

A woman, æt. 28. About fourteen months ago had an eruption of red spots all over the body, and two months after that, an ulcer broke out on the left leg, a little below the knee; this continued for four months. About the end of the following December, a small tumour appeared on the upper eyelid, like a stye; shortly after this the ulcer of the leg healed, and ulceration of both eyelids extended itself. At present there is some swelling and ulceration of the upper eyelid towards the outer angle. The whole tarsal edge of the lower eyelid from near the punctum to the outer corner is destroyed by ulceration. The skin of the lower eyelid for about one-twentieth to one-tenth of an inch from what remains of the tarsal edge of the lid is ulcerated. Three grains of the iodide of potassium, with decoction of sarsaparilla, were ordered to be taken three times a day, and the four-grain nitrate of silver solution to be dropped into the eye, and applied to the ulcerated surface occasionally. After a month's continuance of this treatment, cicatrization along the edge of the eyelid was completed. The patient no longer experienced any distress from the eye in moving it, as she used to do. The mixture was continued, and the weak red precipitate ointment ordered to be applied to the eyelids. In another month the eye was quite well, and the patient was discharged cured.

In the cases of infants affected with syphilis, above referred to (pp. 180—225), in which the eyelids and other parts of the face and body are covered with an eruption of flat broad pustules, which break, scab, and spread; the *general treatment* should consist of minute doses of calomel, one-half grain, or hydrargyrum cum creta one or two grains, three times a day; and the *local treatment* in the application to the edges of the eyelids, of the weak red precipitate ointment.

Some time ago my colleague, Mr. Berkeley Hill, brought under my notice a man with syphilitic tubercles on the skin in the region of his right eye, which had been contracted in the following manner. The man received a blow, causing abrasion of the skin. With a view to prevent discolouration and swelling, a friend sucked the part. After that the disease presented itself. On examination of the mouth of this friend, Mr. B. H. discovered secondary soft sores, from which inoculation had taken place. The man who was inoculated, it should be stated, had, besides the tubercles on his face, a coppery roseolar rash over the forehead and body, but never any sore on the penis; whereas the friend who inoculated him, had previously had chancre.

SECTION II.—ABNORMAL POSITION OF THE EYELIDS, DETERIORATION OR LOSS OF SUBSTANCE OF THE EYELIDS, MISDIRECTION OF THE EYELASHES, IRREGULARITY AND LOSS OF MOVEMENTS OF THE EYELIDS, ETC.

ECTROPIUM OR EVERSION OF THE EYELIDS.

In ectropium the eyelid is drawn away from the eyeball, its conjunctival surface turned out, and its ciliary margin displaced. The eyeball being thus deprived o the protection of the eyelid, is exposed to constant irritation, by which a chronic conjunctivitis is kept up, weakening the eye, and giving rise to specks and vascularity of the cornea. In some bad cases, repeated attacks o acute inflammation may lead at last to destruction of the eyeball. The conjunctiva of the everted eyelid presents more or less of a villous or sarcomatous appearance; and when it is the lower eyelid which is the seat of the disease, there is usually stillicidium lacrymarum. To these accompaniments of ectropium are to be added a distressing sensation of cold in the eye, and very disagreeable disfigurement.

Ectropium occurs in different degrees, and depends on different causes. It more frequently affects the lower than the upper eyelid. Sometimes both are everted.

1st.—*Ectropium from excoriation and contraction of the skin of the eyelid, together with a thickened and sarcomatous state of the conjunctiva.*

It is almost always the lower eyelid which is the seat of this, the simplest and most common form of ectropium. The displacement is usually the result of some chronic inflammation of the conjunctiva, or ophthalmia tarsi, in which the skin of the eyelid and cheek becomes excoriated and contracted. The lacrymal papilla and punctum being at the same time everted, there is stillicidium lacrymarum, which keeps up and aggravates the contraction of the skin on the one hand, and the thickened and detruded state of the conjunctiva on the other.

In old persons, the relaxation of the tarsus and the thickened and sarcomatous state of the conjunctiva, seem to operate more frequently in the production of eversion than any contraction of the skin. In consequence of chronic catarrhal ophthalmia, the angles of the eyelids being eroded, the tarsus relaxed, and the conjunctiva at the same time rendered thickened and sarcomatous, the eyelid falls away from the eyeball and becomes everted; and while the contraction of the orbicularis muscle tends to augment the eversion, this becomes more and more confirmed, principally by the increase of the thickened and sarcomatous state of the conjunctiva, and by the gradual accommodation of the eyelid to its changed position.

By long exposure, the epithelium of the everted conjunctiva assumes in a great degree the characters of cuticle ; so that the conjunctiva becomes callous, and can now bear, without inconvenience, the contact of external bodies, which before caused irritation, and even gave rise to bleeding.

Treatment.—The first thing to be done is to relieve the stillicidium lacrymarum by slitting up the lower canalicule from the everted punctum to near its entrance into the sac.

As in the form of ectropium just described, there is no actual loss of the skin of the eyelid, as the contraction of it is in general not very considerable, and as the sarcomatous state of the conjunctiva, together with the relaxation of the tarsus of the affected lid, have a large share in keeping up the eversion, means calculated to produce contraction of the conjunctiva, either alone or in combination with means calculated to shorten the transversely elongated tarsus, will in general be found sufficient to restore the eyelid to its natural position.

To produce contraction of the morbid conjunctiva, the repeated application to its surface of the lunar caustic pencil is the most convenient method. The eyelid being everted still more by traction on the neighbouring skin, the caustic is to be pencilled on the conjunctiva in a direction from one angle of the eye to the other, parallel to, but at a little distance from, the ciliary margin of the eyelid. After the application of the caustic, the part is to be wiped with a bit of lint, and then pencilled with sweet oil. It is often advantageous to scarify the conjunctiva before applying the caustic. The cauterization may be repeated in the course of three or four days. Instead of lunar caustic, strong sulphuric acid has been recommended for the cauterization of the conjunctiva. It is applied by means of a pencil of wood or bone, care being had in dipping the pencil into the acid that it do not take up so much as to form a drop hanging at its point. The lunar caustic, however, deserves the preference in general ; and when it is found insufficient to effect the desired object, it is better to have recourse to the *excision of an elliptical shaped piece of the thickened and sarcomatous conjunctiva, parallel to the ciliary margin of the eyelid.*

To effect this, the eyelid being drawn as much as possible away from the eyeball by traction on the neighbouring skin, the diseased conjunctiva is to be pinched up with a forceps, and the piece snipped off with curved scissors. The piece removed must be of such a breadth as appears sufficient, in order that when cicatrization is complete, the contraction of the conjunctiva may be neither so much as to invert the eyelid, nor so little as still to leave some degree of eversion.

After cauterization or excision of the conjunctiva, it is well to keep the lid in its proper place by means of strips of plaister and a compress and bandage.

When there is evident transverse elongation of the tarsus, *the excision of a wedge-shaped piece out of the whole substance of the eyelid*, as first practised by Sir William Adams, may, either alone, or in combination with one or other of the means above mentioned, be necessary to restore the eyelid to its natural position. The base of the wedge-shaped piece excised corresponds to the ciliary margin of the eyelid, and must be of such a breadth as will restore that margin to its proper length. The excision should be performed rather towards the external canthus than in the middle of the eyelid.

The breadth of the piece necessary to be excised being duly calculated, the eyelid is to be seized hold of at the

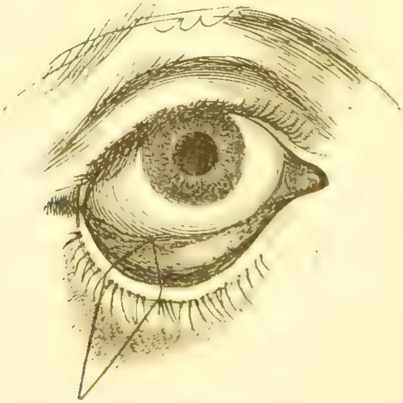

FIG. 145.

place with a forceps, and drawn from the eyeball. Then with a pair of strong straight scissors, the surgeon cuts out the piece at two strokes, the first being made on the left-hand side of the forceps, and the second on the right-hand side. After the excision of the piece, the eyelid is to be restored to its proper position, and the edges of the wound united by the harelip suture.

The pins are to be inserted and brought out at some distance, about one-tenth of an inch, from the edges of the wound, and must not implicate the conjunctiva. The first pin introduced should be close to the ciliary margin of the lid, in order to insure evenness at this place. Lastly, the eyelid is to be supported by strips of plaister and a compress and bandage.

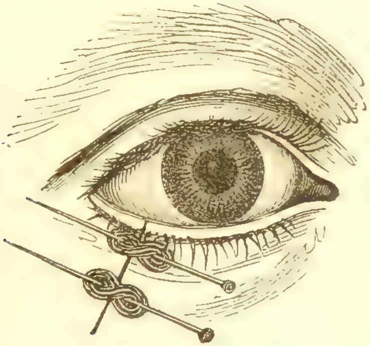

FIG. 146.

2nd.—*Ectropium from contraction of the skin in consequence of cicatrices, &c.*

Ectropium from the contraction of the skin which takes place in consequence of cicatrization, as often affects the one eyelid as the other, and sometimes both, they being equally exposed to the wounds, burns, abscesses and ulcerations, by which the skin and subcutaneous cellular tissue of the eyelids are liable to be destroyed to a greater or less extent. In cases in which the injury of the skin by burn, wound, or other cause, has been at the outer angle, this, together with the outer part of both eyelids, is everted.

In the form of ectropium now under consideration, the eversion is generally very complete, sometimes indeed to so great a degree that the ciliary border of the eyelid, very much elongated, is drawn down upon the cheek or up to the eyebrow, as the case may be. Ectropium of the upper eyelid it is obvious leaves the eyeball much more exposed than ectropium of the lower eyelid.

Treatment.—This form of ectropium has exercised the operative ingenuity of surgeons from a very early period, but it is recently only that much success has been achieved. Beer, writing so late as 1817, discusses this form of ectropium in a section entitled, "*Of the incurable diseases consequent to the ophthalmiæ.*"

The operation described by Celsus for lagophthalmus, or shortening of the upper eyelid, consisted in making a semilunar incision through the contracted integuments of the eyelid "paulum infra supercilium . . . . . cornubus ejus deorsum spectantibus." The eyelid being set free by the incision, was brought into its natural position, and an attempt made to heal the wound thus left by a broad cicatrice. For ectropium of the lower eyelid, he recommends a similar operation, "plagæ tantum," he says, "cornua ad maxillas, non ad oculum convertenda sunt."

This operation, which indeed Celsus recommends only when the loss of skin is inconsiderable,* has been performed over and over again, but it has always been found that the cicatrice gradually contracted until the eversion was as bad or worse than before.

Professor Chelius of Heidelberg has somewhat modified the above operation, and says the results he has thereby obtained have been, even in cases of very considerable shortening of the skin of the eyelid, successful beyond expectation.

Chelius's operation.—An incision is made along the whole breadth of the eyelid, and as near its tarsal edge as possible, through the skin. The edges of the wound are to be dissected from the cellular tissue, so far that all tension of the skin may be removed, and the eyelid admit of being readily brought into its natural position. The fibres of the orbicularis are then to be divided by several vertical incisions. When the replacement of the eyelid is opposed by a considerable tumefaction of the conjunctiva, a portion of this membrane is to be removed by the scissors and knife, and the external commissure of the eyelids slit up, to the extent of some lines, in a horizontal direction. After this, two loops of thread are to be drawn through the skin by means of curved needles, near the tarsal edge of the eyelid, but without wounding the tarsus. These threads are to be fastened by sticking-plaister to the cheek, if the upper eyelid be the subject of operation, to the forehead in the contrary case, so that the eyelid operated on may be retained in its natural position. The wound of the eyelid, and the wound at the angle of the eye, are covered with charpie, which is to be retained in position by strips of plaister, without any other dressing. In the course of the after-treatment, nothing but charpie, dry or smeared with some mild cerate, is to be applied. The touching of the parts with lunar caustic, even when the granulations rise above the edges of the wound, is to be especially avoided, as contraction of the cicatrice is thereby very much promoted.

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* He acknowledges that when "nimium palpebræ deest, nulla id restituere curatio potest."

To the separation of unnatural adhesions or divisions of the contracted skin, and the extirpation of a portion of the everted and sarcomatous conjunctiva, as described in the preceding method, may be added, when there is much transverse elongation of the tarsus, Adam's excision of a wedge-shaped portion of the whole thickness of the eyelid, as above described. Here it may be remarked, that as, in the cases under consideration, the skin is much shortened, it is necessary in performing the excision to make use of a small scalpel instead of scissors.

The Author's operation.—The following operation I performed with success in eversion and shortening of the upper eyelid, from contraction of the skin consequent to a burn. The peculiarity of the plan consists in the following particulars:—The eyelid is set free by incisions made in such a way, that when the eyelid is brought back into its natural position, the gap which is left may be closed by bringing its edges together by suture, and thus obtaining immediate union. Unlike the Celsian operation, the narrower the cicatrice the more secure the result. The flap of skin embraced by the incisions is not separated from the subjacent parts; but advantage being taken of the looseness of the subcutaneous cellular tissue, the flap is pressed downwards, and thus the eyelid is set free. The success of the operation depends very much on the looseness of the cellular tissue. For some days before

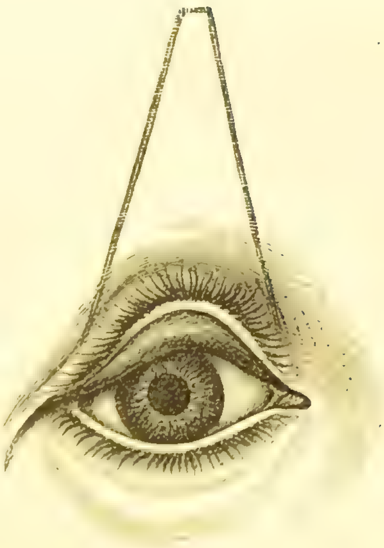

Fig. 147.

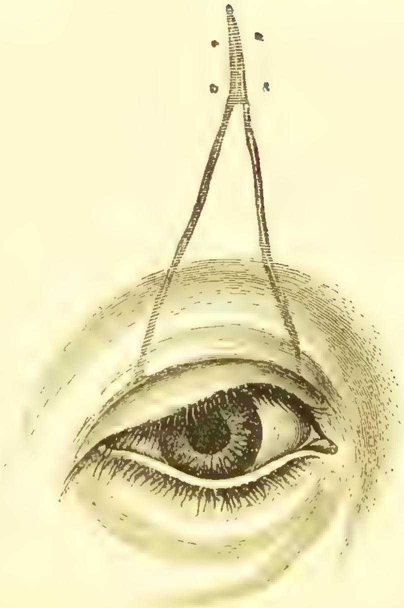

Fig. 148.

Fig. 148 shows the right eye after the parts had healed; the cicatrice where the gap was, and the marks of the sutures.

the operation, therefore, the skin should be moved up and down in order to render the cellular tissue more yielding.

A description of the operation is comprehended in the following case:—A woman, aged twenty-four, had her face much scarred. Both eyeballs were quite exposed, on account of shortening and eversion of the upper eyelids. On the left side the eversion of the upper eyelid was not so great as on the right. On this side the ciliary margin of the tarsal cartilage corresponded to the edge of the orbit, and the opposite margin of the cartilage occupied the usual position of the ciliary margin; so that when an attempt was made to close the right eye, it was the orbital margin of the tarsal cartilage which was pressed down. There was some degree of shortening and eversion of the left lower eyelid. The patient saw very well with the right eye; but with the left, on account of opacity of the cornea, she did not see well enough to recognise a person. At the age of one year and three months she fell into the fire, and had her face severely burned, which was the cause of the state above described.

Two years before coming under my care, she had an operation performed on the left eye, and derived advantage from it. It is probable, however, that the eversion only had been lessened by the operation, for the shortening of the upper eyelid was still very great.

I operated on the *left* upper eyelid first. Two converging incisions were made through the skin, from over the angles of the eye upwards to a point where they met, somewhat more than an inch from the adherent ciliary margin of the eyelid. By pressing down the triangular flap thus made, and cutting all opposing bridles of cellular tissue, but without separating the flap from the subjacent parts, I was able to bring down the eyelid nearly into its natural situation, by the mere stretching of the subjacent cellular tissue. A piece of the everted conjunctiva was snipped off. The edges of the gap left by the drawing down of the flap were now brought together by suture, and the eyelid was retained in its proper place by plaisters, compress, and bandage.

During the healing of the wound, a small piece of the apex of the flap, which had been somewhat separated from the adjacent parts, sloughed. In a month, healing had taken place, and the eversion completely cured. The cicatrice where the part had sloughed was pretty broad. When the bandages were first left off, the eyelid was so elongated, that if the lower eyelid had not also been shortened, the eye would have been entirely covered. After leaving off the bandages some shortening took place, from contraction not of the cicatrice, but of the skin. Being no longer on the stretch. the skin assumed, as it contracted, more of its natural appearance.

The *right* upper eyelid was next operated upon. The incisions were made in a similar manner (Fig. 147, page 628), except that they did not meet in a point, a space being left between their extremities to the extent of about one-sixth of an inch, which was divided by a transverse cut.

By the stretching of the subjacent cellular tissue, I succeeded in drawing down the flap, and thus elongated the eyelid so much that it covered the eye entirely; but in consequence of the long-continued displacement of the tarsal cartilage, the ciliary margin of it did not come into contact with the eyeball. I did not interfere with this state of parts, by attempting any transverse shortening of the lid, but a piece of the everted conjunctiva was removed, and with it a bit of the tarsal cartilage. From the surface of this wound there sprang out a small soft fungus, which was cut off with the scissors, and the root touched with the lunar caustic pencil.

The above operation has been repeated by M. A. Bérard, without success; and by M. Velpeau, successfully in one case, and unsuccessfully in another, in which erysipelas came on.

Tarsoraphia.—It has been mentioned, that it sometimes happens that, from bad cicatrices, the skin of the temple is much contracted, and the external commissure, together with the other parts of the lids, everted in consequence. In such a case, Walther excised the tarsal edges of both eyelids where they were everted, together with the commissure and a triangular piece of the neighbouring integument of the temple, the base being towards the eye, and the apex towards the ear (Fig. 149). He then united the edges of the wound by two sutures; and the eversion was by this *tarsoraphia* cured. (Fig. 150).

In similar cases, but with more complete eversion of both eyelids, Dieffenbach made to the above proceeding of Walther the following additions. After the excision of the triangular piece from the outer canthus, a curved incision was carried above the supra-orbital arch; and another, below the lower margin of the orbit, and towards the nose. The two crescentic flaps were then raised; and, after closing the wound in the temple, they were adapted as new lids to the remaining conjunctiva.

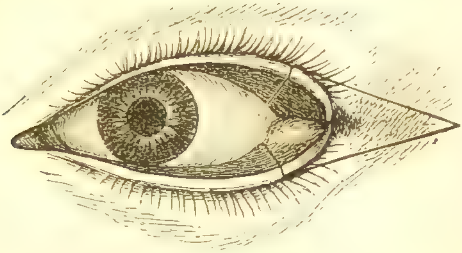

FIG. 149.

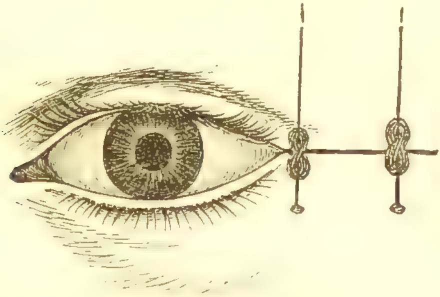

FIG. 150.

3rd.—*Ectropium from caries of the orbit.*

When ectropium is complicated with caries of the margin of the orbit, nothing in the way of operation in reference to the ectropium should be attempted, until the disease of the bone is cured. Then, it will generally be necessary, on account of the extent to which the skin of the eyelid has suffered from the carious suppuration and ulceration, to have recourse to transposition of the neighbouring skin, according to some one of the operations above described, or to transplantation. It, however.

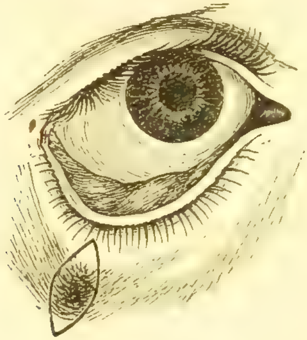

Fig. 151.

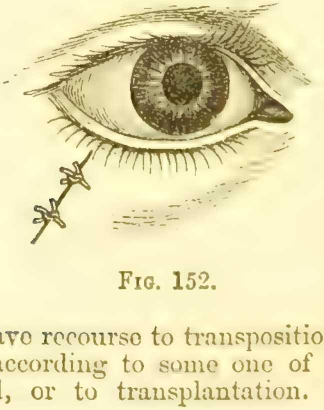

Fig. 152.

sometimes happens, that, though the eversion is considerable, a very small part of the skin only is drawn into the cicatrice, whilst the surrounding skin, still pretty healthy, is puckered. In a case of this kind, Dr. Ammon surrounded the adherent part of the skin by an incision. Leaving it on the bone, he detached the neighbouring integuments all round, to such an extent that the lid was set at liberty, and the patient could shut the eye. He then closed the external wound over the old cicatrice. The lid was in this way elongated, a scarcely observable scar remained, and the disagreeable depression at the edge of the orbit was no longer in view.

In performing this operation, the surface of the piece of skin left adherent to the bone ought to be shaved off, so as to make the bottom of the wound raw.

In such a case, in which the adherent skin still retained some thickness, I have, by subcutaneous section, detached it from its morbid connection with the bone, and thus restored the eyelid nearly to its natural position.

4th.—*Transplantation of skin as a means of supplying a deficiency of the eyelids.*

Transplantation of a flap of skin according to the Indian method.—When, after the separation of unnatural adhesions, the extirpation of a cicatrice, or the division of the simply contracted skin, the gap left by the reinstatement of the eyelid in its natural position is very considerable, attempts have been made to transplant a portion of skin from some neighbouring part into it. The flap of skin to be transplanted is usually taken from the temple when the upper eyelid is the subject of operation,—from the cheek in the case of the lower eyelid, and is made of a form corresponding with the gap, but of a size considerably larger, in order to allow for the contraction which subsequently takes place. The flap, previously measured and traced in outline, is raised by dissection, along with as much of the subjacent cellular tissue as possible, but is still left in connection with the body by a slip as broad at least as itself. After all bleeding has ceased, and after removing any clotted blood that may be in the gap in the eyelid, or adhering to the flap, the latter is to be so transposed that it may be adjusted to the former, with the edges of which it is to be fixed by stitches, strips o plaister, and bandage. The wound in the temple o cheek whence the flap was removed is to be closed by bringing its edges together, with stitches if possible, i

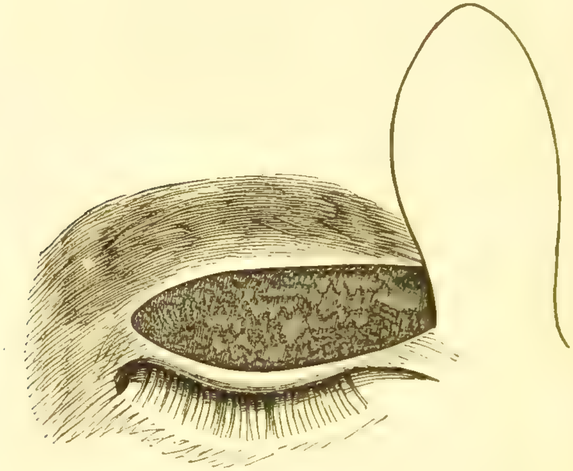

FIG. 153.

not, it is to be allowed to granulate and heal in the ordinary way.

The operation by transplantation of the skin has, in the hands of the late Dr. Fricke, of Hamburg, who first performed it, Dr. Mackenzie, and others, been crowned with success, but in several cases it has failed.

Transplantation of a flap of skin according to the Italian or Taliacotian method.—Five years ago my friend Dr. J. C. Cumming introduced a gentleman to me, for consultation respecting the state of his right eye.

The whole substance of the upper eyelid—skin, tarsal cartilage, and conjunctiva—had been destroyed by ulceration to the extent of two-thirds next the temple. The outer canthus was also destroyed, but the inner canthus was entire. The small undestroyed portion of the eyelid next the latter was everted.

In consequence of the destruction of the outer canthus, the lower eyelid hung down on the cheek in a state of ectropion.

The eyeball was reduced to a stump, and its conjunctiva had become cuticular from exposure.

The outer part of the eyebrow had likewise been destroyed, and the integument, which had been reproduced in that situation, was thin and tense. With this morbid integument of the eyebrow, the cuticular conjunctiva of the eyeball was continuous all along where the eyelid had been destroyed, and was in consequence, so much on the stretch that the stump of the eyeball was kept drawn upwards and outwards.

The conjunctiva of the everted remains of the upper eyelid was also continuous with the morbid integument of the outer part of the eyebrow.

The skin of the temple was in a shrunken and cicatrised state from having likewise been the seat of ulceration.

Immediately above the eyebrow, the skin of the forehead was healthy.

Figure 1, Plate VIII., represents the eye the state of which has just been described.

The means which suggested themselves for the rectification of this great disfigurement were a restoration of the lost upper eyelid, and the reinstatement into its proper position of the everted lower eyelid.

Towards the accomplishment of this object, I performed the following preparatory operation on the 24th of July, 1860.

In the healthy skin of the forehead, immediately above the place where the eyelid was destroyed, two incisions were made from above downwards, diverging like the legs of the letter A: only that they were commenced, not at a common point, but at a short distance from each other. The intervening skin was afterwards divided by a transverse incision. Of the two diverging incisions, one terminated by the side of the remains of the old eyelid, and the other near the situation of the outer canthus.

The base of the angular flap thus marked out corresponded to the place where the destroyed portion of the eyelid had been.

In figure 154, *a* and *b* represent the diverging incisions, c the transverse incision uniting them.

By pressure, the flap was now made to slide down as far as the looseness of the subjacent cellular tissue woul allow.

A cushion of thick skin was thus obtained for th outer part of the eyebrow, whilst the thin skin which i replaced, together with the ocular conjunctiva, formed fold occupying the situation of the lost portion of th eyelid.

An incision (*d*, Fig. 154) was next made through th

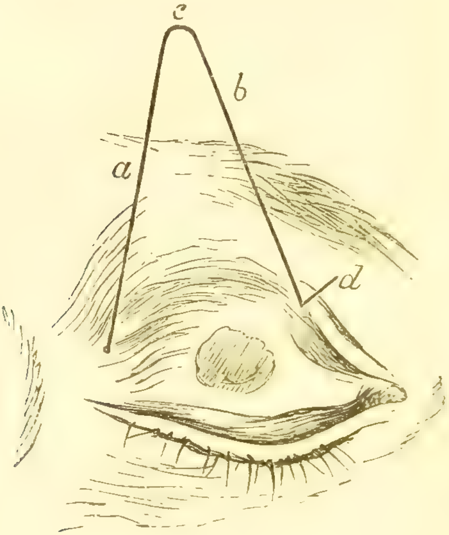

Fig. 154.

thickness of the remains of the old eyelid, which allowed of that part being brought down somewhat from its everted position.

The edges of the hiatus left by the drawing down of the angular flap were brought together by a stitch. The flap itself was secured in its new position by stitches between its sides and the adjacent skin. Lastly, the remains of the old eyelid, now somewhat more in place, was united by a stitch with the corresponding side of the newly obtained palpebral fold.

The operation was concluded by making raw the edge of the lower eyelid at the outer canthus, and uniting it by suture with the adjacent part of the palpebral fold.

likewise made raw, so as to correct the eversion of the lower eyelid.

Figure 155 represents the state of parts after the insertion of the stitches.

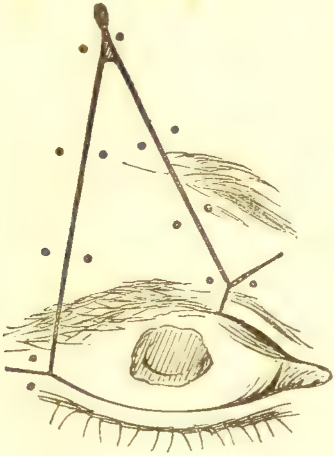

FIG. 155.

The parts were further supported in their new position by plaisters, compress and bandage.

The healing of the wounds took place quickly and kindly.

The first step of the operation now described, viz., the marking out an angular flap of skin by incisions, and, without raising it by dissection, bringing it down by sliding merely, advantage being taken of the looseness of the subcutaneous cellular tissue for this purpose, is identical with the operation above described, p. 627, for the cure of eversion and shortening of the upper eyelid from contraction of the skin consequent to burns. The second step of the operation, viz., the incision for bringing down the remains of the old eyelid, is founded on a principle which I successfully adopted in the operation for cleft and retracted eyelid (*Coloboma palpebræ et lagophthalmos*) described below, p. 662, and originally recorded in the *Medical Times and Gazette* for August 22, 1857.

The gain from the operation was as follows:—

1st. The lower eyelid was restored to its natural position.

2nd. The small portion of the upper eyelid still remaining was rendered less everted.

3rd. A fold of skin and conjunctiva was obtained in the situation of the lost portion of the eyelid.

4th. The stump of the eyeball could be moved more freely.

5th. A cushion of thick skin was obtained for the outer part of the eyebrow in replacement of the thin skin brought down to form along with the ocular conjunctiva, the palpebral fold before mentioned.

This gain, however, was far short of the accomplishment of the desired object. Something entitled to the name of an upper eyelid had yet to be formed; but where to find materials for the purpose was the question.

The fold of skin and conjunctiva obtained in the situation of the lost portion of the eyelid, together with the conjunctiva of the still remaining portion of the old eyelid, promised to yield the material for a palpebral conjunctiva, if skin could only be obtained for the outside of the eyelid. To borrow skin from the temple was out of the question, for, as before stated, the skin in that region was in a shrunken and cicatrized state from having been the seat of ulceration at the same time that the eyelid was destroyed.

I proposed, therefore, to take the required flap of skin from the hand by transplantation, according to the method of Taliacotius—a proposal to which my patient readily agreed. I explained to him that it would be necessary to keep his hand applied to the eye for some days, and that such a constrained position would demand much endurance on his part. He assured me, however, that he was prepared for any such inconvenience by past experience, for he had been in the habit, whilst the ulceration was going on, of keeping his hand applied, for weeks together, over the eye as a means of mitigating the pain he suffered.

The operation having been determined on, an apparatus for the support of the elbow was prepared, consisting of a leather cap fixed to the arm by straps and secured at a proper height by a belt round the neck. With the arm supported by this apparatus, and the hand, lying over the eye, secured by a bandage round the head, the patient passed a night or two in order to become habituated to the position, so that he might not, after the operation had been actually performed, run the risk of starting during sleep, and so displacing the hand with the transplanted flap from over the eye.

These preliminaries having been settled, I proceeded to perform the operation on the 26th of September—just two months after the performance of the preparatory operation already described.

The elbow was in the first instance secured in the suspensory apparatus provided for it, in order to have the hand ready for the formation and application of the flap.

I then made an incision through the skin immediately below and concentric with the arch of the orbit from over the inner canthus to over the outer canthus, as represented in figure 156, and by dissection brought the skin and conjunctiva composing the palpebral fold, and also the remains of the old eyelid, down to an extent sufficient to cover the stump of the eyeball in the manner of an eyelid. The hiatus in the skin thus produced was of an oval shape, about one and a half inch long in the direction from canthus to canthus, and half an inch broad in the vertical direction.

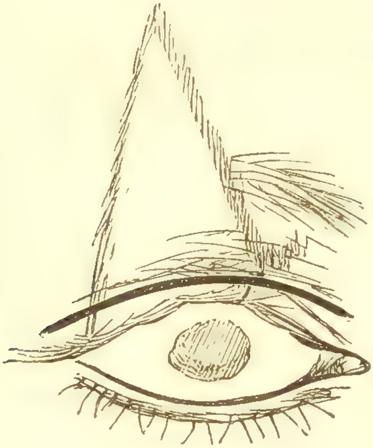

Fig. 156.

The next step of the operation was to mark out by incision and raise the flap of skin from the ball of the thumb. To allow for shrinking, the flap was made somewhat larger than the hiatus it was to fill up. The bridge of skin by which the flap was retained in connection with the hand, was about half an inch broad and a quarter of an inch long. Figure 157 represents the flap and connecting bridge of skin as raised up by dissection.

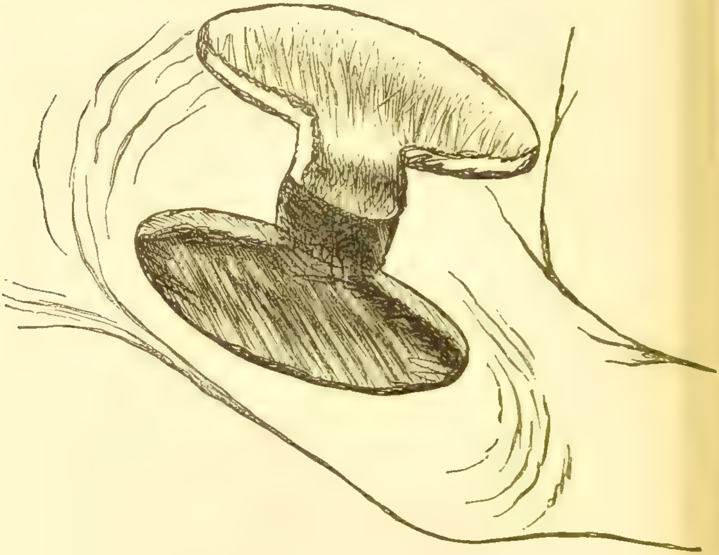

Fig. 157.

The bleeding from the flap and from the hiatus into which it was to be received was allowed to cease spontaneously. No bathing with water, cold or warm, was had recourse to. The bleeding had ceased for some time before the flap was adjusted in its place. The lymph on the raw surfaces was that of the effused blood entangled in the interstices of the cellular tissue.

The bleeding then having ceased from both wounds, preparation was made for the adjustment of the flap into the hiatus it was to fill, by drawing in the threads for the stitches. Each thread was drawn in at the corresponding points of the flap and border of the hiatus where it was intended to make the stitch. To allow of this, the threads were left long.

Everything being now ready, the hand was laid over the forehead and the eye, the flap fitted into the hiatus and the threads for the stitches drawn tight and tied. Three stitches secured the upper margin of the flap, and two the lower. The two latter were close by the side of the bridge, retaining the flap in connection with the ball of the thumb.

The adjustment of the flap and tying of the stitches constituted the nicest part of the whole operation, as the work had all to be done behind the hand lying over the place.

The operation was completed by tightening the belt of the suspensory apparatus round the neck and securing the hand to the head.

While the ball of the thumb and its flap lay over the eye, the thumb itself lay over the temple, and the fingers were spread over the forehead. The thumb and the fingers were in the first instance stuck to the skin on which they rested by means of Burgundy pitch. A long band of adhesive plaister was then extended over the fingers from one side of the forehead to the other. Lastly, several turns of a roller were passed round the head and over the hand.

The patient bore the operation with great fortitude, though the incision along the margin of the orbit, especially, was very painful.

For the first two or three days after the operation, the patient was rather feverish, sick at stomach, and without appetite. On the evening of the second day he complained of considerable pain over the eye. That night he took two grains of calomel with ten grains of Dover's powder, which appear to have operated beneficially, for he did not again suffer anything more than a feeling of soreness such as was to be expected. After the third day he regained his appetite, and began to recover from the depression which followed the operation.

The constrained position of the arm, however, now became a cause of considerable distress. There was pain in the elbow shooting up the arm. In the hope of relieving this, the elbow-cap was taken off and rearranged, but without much benefit. After another day's use of it, therefore, it was laid aside altogether, and a simple sling of cloth substituted, which proved less uncomfortable than the cap. What gave most temporary relief to the elbow was bathing it with cold vinegar, and after this, binding a sponge moist with the vinegar in the bend of the arm.

Notwithstanding all the uneasiness suffered, the hand was very successfully maintained in position.

On the sixth day after the operation, i. e., on Tuesday, the 2nd of October, I cut the connecting bridge of skin between the transplanted flap and the ball of the thumb, and thus, to the patient's great relief, set free his hand and arm.

As the patient's hand necessarily covered his eye, the division of the connecting bridge of skin was as delicate a part of the operation nearly as the adjustment of the flap and tying of the stitches had been at first.

The bandage round the head and over the hand was first removed, and also the band of adhesive plaister which had been extended over the fingers from one side of the forehead to the other. My assistant now holding the patient's head and arm firmly, in order to guard against any sudden start, and the patient himself being prepared to resist any impulse to move which the pain of cutting the bridge of skin might occasion, I cautiously raised the thumb from over the temple until I got a distinct view of the bridge to be cut. I then passed a pair of scissors behind the hand, and again warning the patient to be steady, snipped through the bridge of skin close to the edge of the eyelid. This division of the connecting bridge of skin caused pain.

As soon as the division was made, I laid the patient's hand on his left shoulder, and directed my attention to the eye, when I was much gratified to find the transplanted flap adherent throughout in its new position. In the line of union with the neighbouring skin, I observed that the edges of the flap presented here and there florid and exuberant granulations.

The two stitches at the lower border of the flap had already separated by ulceration; it remained, therefore, only to remove those securing the upper border. This being done, strips of fine isinglass plaister were applied over the flap to the neighbouring skin. A strip of adhesive plaister was also applied at the outer canthus, in order to keep the lower eyelid raised towards the newly formed upper eyelid. A fold of lint was then laid over the eye, and the whole secured by a bandage round the head.

When the bridge of skin between the hand and the transplanted flap was divided, very free bleeding took place from that side of it in connection with the hand;

whilst from the cut edge on the side of the flap there was no bleeding.

The eye having been dressed, the wound of the hand was next attended to. Granulation and suppuration had already commenced. The bridge of skin, by which the flap had been kept in connection with the hand, was laid back into its place, and the rest of the wound was covered with charpie, over which a compress was laid, and the whole bound up.

On Friday, the 5th of October, the fold of lint over the eye was removed, the eye bathed with lukewarm water, and a light covering substituted for the bandage. The granulations which had been observed here and there at the margin of the flap, when by the section of the connecting bridge of skin the hand was removed from over the eye, and the flap thereby exposed to view, had now all become shrunk.

On Saturday, warm water dressing was laid over the eye at bed-time.

On Sunday, the strips of isinglass plaister, which had thus become softened, were removed. The epidermis of the transplanted skin was found white, thickened, and softened by the moisture.

On Monday, this white, thickened, and softened epidermis peeled off, and the transplanted flap of skin was found covered with a new and more delicate epidermis, and now distinctly seen to be adherent throughout its whole extent in its new situation. It had become considerably contracted in length and breadth, but increased in thickness, as appeared from its prominence at the surface.

From the time that the flap was first exposed, the patient affirmed that he could feel when the skin was touched. It might, however, be doubted whether the sensation experienced by the patient was not caused by the mechanical impulse communicated from the flap to the very sensitive parts underneath with which it had become organically connected. However this may be, it is certain that from the time the old epidermis of the flap peeled off, the patient had undoubted sensibility in the transplanted skin. This sensibility has gone on to increase.

The conjunctiva, which was previously cuticular, and the delicate skin continuous with it, which had together formed the palpebral fold after the first operation, and which had now been unfolded and brought down to form the palpebral conjunctiva of the new eyelid by this second operation, had assumed something of a real conjunctiva-like appearance, and was the seat of some puro-mucous secretion.

The upper and lower eyelids not having sufficiently approximated at the outer canthus, it was necessary subsequently to excise a small triangular portion of the morbid skin, to make raw the edges of the eyelids at the place, and to unite them by suture. Close and solid adhesion, however, was not obtained, in consequence of the morbid condition of the skin concerned.

The result of this operation has been :—1st. The formation of something entitled to the name of an upper eyelid, and the consequent re-establishment of an oculo-palpebral space. 2nd. The restoration of the edge of the remains of the old eyelid to its natural position. 3rd. The stump of the eyeball is now capable of being moved freely in all directions.

The oculo-palpebral space was at first fit for the reception of an artificial eye; but shrinking of the new eyelid subsequently took place to such an extent that the artificial eye could not be retained.

Though the transplanted flap has shrunk considerably, there is still as much skin outside as there is conjunctiva inside. Figure 2, Plate VIII. represents the eye as it now appears, five years after the operation.

In concluding this case, it may not be irrelevant to make some general remarks on Autoplasty, and to endeavour to trace how the circulation is carried on in the transplanted flap of skin before and after severance from its original connections.

Circulation in the transplanted flap before severance from its original connections by division of the bridge of skin.—Although capillaries all communicate directly or indirectly with each other, a given part of the capillary network receives its blood especially from the branches of a particular artery, and pours its blood especially into particular venous radicles. The *Vis a tergo* in a given artery, therefore, operates with effect chiefly on the part of the capillary network to which its branches lead, and on the corresponding venous radicles.

In the case before us, however, suppose that but a single artery with its accompanying vein entered the transplanted flap by the bridge of skin, the ramifications of the artery would have had to supply with blood not only the capillaries to which they more directly led, but also all the other capillaries of the flap. In order to supply these other capillaries, the ramifications of the artery would have had to pour blood into the inosculating ramifications of those arteries which, in dissecting up the flap, were cut at different points both of its under surface and edges. The blood thus received by the inosculating ramifications of the cut arteries would have had to flow in them in a retrograde direction, in order to pass out into the capillaries to which they led. The direct inosculations between the two sets of capillaries in question would also have been a means of supply to those whose source had been cut off by the section of the arterial trunk, the ramifications of which led to them.

As to the way in which the blood would have been carried away from the capillaries of the flap:—The vein accompanying the artery in the bridge of skin, besides receiving by its own radicles the blood from the capillaries which were more especially supplied by the last ramifications of its accompanying artery, would have had to receive the blood from the other capillaries through its inosculations with the ramifications of the venous trunks which were cut in dissecting up the flap—in which ramifications, the blood must have had to follow a retrograde and circuitous course.

The force of the heart having thus, under the conditions which we have supposed, to operate through one small artery, not only on the capillaries to which that artery more especially leads, and the venous radicles arising therefrom, but also on neighbouring parts of the capillary net-work (which it does partly through the inosculations which the branches of the artery have with those of neighbouring arteries, and partly through the direct inosculations between the capillaries themselves, and thence on the venous radicles arising from those neighbouring parts of the capillary system), the circulation in the flap must necessarily be very sluggish. The result of this retarded flow of blood, however, it is to be observed, is not a diminished supply but a congestion, especially at the cut edges and under surface of the flap. Such congestion within due limits is a necessary condition for the process of adhesion.

Sloughing of the flap, when it takes place in plastic operations before severance of the flap from its original connections by division of the bridge of skin, appears to be owing, not to a deficient supply of blood, but rather to excessive congestion and stagnation of the blood in the vessels, either in consequence of the *vis a tergo* in the artery being too weak to keep up the circulation, or in consequence of the venous channel not being sufficient for the return of the blood, or in consequence of both these causes combined. A more general cause, to be found in a morbid state of the blood itself, may also be in operation either alone or in aid of the local conditions just mentioned.

Circulation in the transplanted flap after severance from its original connections by division of the bridge of skin.—The shrinking in size which the flap has undergone (in the case which forms the subject of these remarks) since the operation, appears to be due to atrophy rather than to mere contraction of the dermic tissue. Simple contraction of the dermic tissue did take place at the time of the operation, but to a comparatively slight extent.

Atrophy of the flap may be accounted for, if we consider that after the division of the bridge of skin connecting it with the hand, the principal source of its supply of blood would be cut off. The only channels by which it could then receive blood would be the new vessels establishing a communication between its own and those of the part on which it had, by the adhesive process, become engrafted. Such vessels, developed in the lymph exuded between the adhering surfaces, would, however, be at first of capillary minuteness, and, therefore, not calculated to transmit any great supply of blood to the flap.

That the flap, as long as its connection with the hand was kept up, was well supplied with blood, was evident from the luxurious granulations above mentioned as observable here and there at its margin, when, by the section of the connecting bridge of skin, the hand was removed from over the eye and the flap thereby exposed to view. That there was considerable determination of blood to the flap, though without any undue engorgement, was, indeed, directly evident from the very free bleeding which took place from that side of the bridge of skin in connection with the hand when it was divided. That, on the contrary, the flap after its severance from the hand, received no great supply of blood through its new vascular connection, was indicated by the absence of bleeding from the cut edge of the flap on the division of the connecting bridge of skin, and by the circumstance that on the third day after the bridge of skin was cut, the florid and exuberant granulations which the margin of the flap had presented at the time of division, here and there in the line of union with the adjacent skin, had all become shrunk.

Possibly, if the connection betwen the hand and the flap could have been maintained longer than it was, the latter would not have shrunk so much in size as it has done. The newly developed vessels would have thereby had time to become larger, before the supply of blood from the hand was cut off.

In cases of transplantation of skin from the temple in which it has not been necessary to sever the flap from its original continuity by dividing the bridge of skin, no shrinking of the flap to any great extent has taken place.

A flap of skin transplanted from a distant part, inasmuch as it has to be entirely severed from its original connections as soon as possible, would thus appear not to be so favourably conditioned as a flap borrowed from the immediate neighbourhood and not requiring its bridge of connection to be severed entirely from its original continuity, or at least not for a long time.

In rhinoplastic operations, the original continuity of the transplanted flap is severed after adhesion has taken place; but in the operation of transplanting the skin from the forehead according to the Indian method, the severance may be delayed for any length of time, which cannot be done in the operation of transplanting the skin from the arm according to the Italian or Taliacotian method.

So far rhinoplasty according to the Indian method is preferable to that according to the Italian. In the former case, however, it may be observed, in passing, that the large scar on the forehead resulting from the removal of the flap of skin is a disfigurement to be weighed against that for the rectification of which the operation is undertaken. Besides, the scar on the forehead is a certain result, whilst the restoration of the nose may not prove successful. The operation according to the Taliacotian method is not attended by any such disadvantage, and if it does not succeed, there is not so much loss.

Re-establishment of the circulation in a part which has become reunited after having been completely severed from the *body.*—The records of Surgery contain many cases in which points of fingers, noses, and pieces of the external ear which had been completely severed from the body have, on being replaced, become reunited.

The following case of reunion of the point of the thumb which had been chopped completely off, I adduce not for its novelty, but for the sake of comparing the phenomena as regards reunion attending it with those attending transplantation of a flap still in connection with the body by a bridge of skin.

A man in chopping wood cut off the point of the thumb of his left hand obliquely, including about two-thirds of the nail, or more.

The man picked up the detached point and wrapped it in his pockethandkerchief. He then had the stump dressed with lily leaves steeped in brandy,—a popular vulnerary,—and bound up with rags. After this, he walked about half a mile to consult my brother, to whom I am indebted for the case. The man having given an account of the accident, laid his handkerchief on the table saying that the point of the thumb was wrapped up in it; whereupon my brother lifted up the handkerchief and shook it open. In doing this, the piece of thumb fell on the floor. Being picked up, it was left lying on the table until the wound of the stump had been bathed with warm water, when it was replaced and secured *in situ* by means of strips of adhesive plaister.

The dressings were left on for ten days without being touched. At the end of that time, the plaisters were removed and replaced by fresh strips, not all at once, however, but only bit by bit at daily intervals. Altogether a week was occupied in doing this. In about three weeks all the plaisters were removed at once, when the detached piece was found to have reunited. Its epidermis and nail had exfoliated, and it appeared shrunk and shrivelled.

After this, the patient was lost sight of for eight or nine months. When he presented himself again, my brother found that the point of the thumb had recovered its natural plumpness. It was now covered with a new epidermis and nail. So completely had the nail been reproduced, that no cicatrice was observable on the back of the thumb. The only cicatrice observable was on the skin of the point and that was a mere line.

Numbness of the point of the thumb was the only thing that remained to remind the patient of his accident.

Whilst a part completely severed from the body, such as the point of a finger, on being replaced and retained in its old position, thus frequently becomes reunited, attempts to transplant completely detached flaps of skin to a distant position, have, I believe, generally if not always, proved unsuccessful.

In cases such as that just related, in which a completely detached part has become reunited in its old position, it is probable that the mouths of the divided vessels, having been replaced in accurate apposition, had directly united so that the circulation admitted of being at once re-established in its old channels.

In wounds of the web of the frog observed under the microscope, I have seen union of divided vessels take place and the consequent re-establishment of the flow of blood in its old channels.

In the cases in which attempts have been made to transplant completely detached flaps of skin to a distant position, it is obvious that no such direct re-establishment of the circulation could take place.

ENTROPIUM, OR INVERSION OF THE EYELIDS.

Entropium is the converse of ectropium. The free margin of the eyelid with the eyelashes is turned in against the eyeball, which they keep in a state of great irritation by the friction they exert upon it.

The margin of the eyelid may be inverted in part of its extent only, constituting *partial* entropium; more commonly the entropium is *total*. One eyelid only may be affected, or both eyelids together of one eye. Sometimes one eyelid of one eye, and one eyelid of the other; sometimes again both eyelids of both eyes are turned in.

The distress occasioned by the friction of the margin of the eyelid, and the eyelashes, against the eyeball when an attempt is made to use the eye, together with the intolerance of light which is usually present in a greater or less degree, forces the patient to keep the eye always closed, or half closed, and as much as possible at rest.

In consequence of the constant irritation which attends entropium, chronic conjunctivitis with vascularity of the cornea is kept up.

Entropium is to be distinguished from *trichiasis*, which is attended by the same distressing irritation. In trichiasis, the margin of the eyelid retains its proper position, whilst the eyelashes only are inverted. Entropium and trichiasis, however, not unfrequently co-exist.

There are different forms of entropium depending on different morbid conditions of parts, and therefore requiring different modes of treatment.

Entropium may be owing to—1. Relaxation of the integuments of the eyelid, and spasmodic contraction of the orbicularis palpebrarum muscle when long continued. 2. A contracted and deformed state of the tarsal cartilage.

1st.—*Entropium from relaxation of the integuments of the eyelid, and spasmodic contraction of the orbicularis palpebrarum muscle.*

In consequence of the firmness and breadth of its tarsal cartilage and the existence of the levator palpebræ muscle, simple relaxation of the integuments of the upper eyelid seldom produces entropium; it merely hinders the eyelid from being freely raised, constituting one form of ptosis. It is the lower eyelid which is most generally the seat of entropium from relaxation.

In this form of entropium, the margin of the eyelid and the eyelashes are in other respects perfectly natural, and the tarsal cartilage appears to be healthy. The eyelid is simply rolled back upon itself, sometimes so much round that the margin with the cilia lies in the inferior palpebral sinus of the conjunctiva. If the finger be applied to the outside of the eyelid and the skin pressed down a little, the margin of the lid with its eyelashes readily starts into its place, and will continue so of itself until the patient winks, when it will fall back with a jerk into its former state of inversion.

A relaxed and superabundant state of the integuments of the eyelid, does not appear to be of itself the essential cause of this entropium; it appears merely to favour its development at first, and to allow of its continuance afterwards. The displacement inwards of the margin of the eyelid, will usually be found to have taken its rise in the following manner. During an attack of ophthalmia attended by a swollen or œdematous state of the eyelids, hese being long kept closed or ven spasmodically contracted, the dge, overbalanced by the puffy tate of the orbital portion of the id is pressed or turned inwards by he ciliary portion of the orbicuaris muscle. A wrong direction aving been thus acquired, it coninues even after the subsidence of ll swelling or œdema. The form f entropium just described is most requently met with in old persons, ence named *Entropium senile.* In hem it is liable to come on after perations for cataract, &c.

When no relaxed and superabundant state of the integuments of the eyelid exists, entropium may be produced by the spasmodic contraction of the orbicularis muscle, during an acute attack of inflammation with intolerance of light, and a swollen state of the eyelids; but it will cease on the subsidence of the ophthalmia, especially if care be taken to keep the eyelid in its proper place by some mechanical contrivance. A layer of collodion, renewed every second or third day, will sometimes answer, but the most efficient and convenient contrivance for this purpose, is a bit of firm wire, so twisted and bent as to fit on the back of the head by its middle, and press by its rounded extremities against the orbital portion of the lower eyelid.

Treatment.—A perpendicular incision through the whole thickness of the border of the eyelid near the outer canthus, as described below for cases of entropium of the lower eyelid from transversely contracted tarsus, is in some cases alone sufficient to correct the inversion.

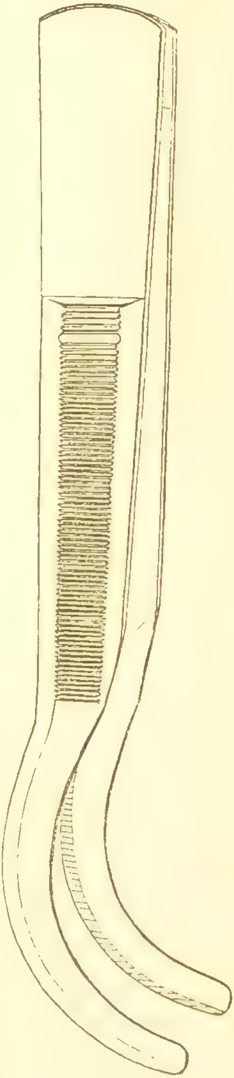

Fig. 158.

The operation commonly performed consists in the excision, or the destruction by caustic, of a portion of the relaxed integuments.

Excision.—The portion of integument removed should be of an elliptical shape, and of such a breadth that when the edges of the gap which is left are brought together, the eyelid will be retained in its proper position. Though the piece of integument ought to be removed as near as possible to the margin of the eyelid, a sufficient breadth of skin must still be left at the margin for the insertion of stitches.

To effect the removal of the piece of integument in the form of an ellipse, a transverse fold, of a size sufficient to bring the eyelid into its proper place, is to be taken hold of with the entropium forceps (Fig. 158, p. 651), and snipped off with a pair of scissors. After the excision of the fold, the edges of the wound are to be brought together by two stitches. It is frequently advisable to add to the transverse excision of the fold of skin, the perpendicular incision through the whole thickness of the border of the lid near the outer canthus, above referred to and as more particularly described below in cases of entropium of the lower eyelid from transversely contracted tarsus.

This excision of a transverse fold of integument may in some cases be advantageously followed up by the excision of a vertical fold, as has been done by Dzondi. A mode of operation practised by Janson of Lyons consists in the excision of vertical folds of skin alone, extending to near the free edge of the eyelid.

Cauterization.—The escharotic most commonly used for this purpose is concentrated sulphuric acid. By means of a pencil of wood, the acid is to be rubbed over an oval portion of the integuments of a length corresponding to the inversion, and about one quarter of an inch broad in the middle. After a few minutes the eyelid is to be dried with a bit of lint and the application of the acid repeated, and this again and again, until a sufficient contraction of the skin is produced so as to bring the eyelid into its proper position. It may be necessary after a time to repeat the application of the acid. Caustic potash I have found more manageable than the sulphuric acid.

Cauterization is not admissible in cases where the skin is very superabundant. It is best adapted for slight and recent cases, or cases in which after excision there is still some tendency to turn in.

2nd.—*Entropium from a contracted and deformed state of the tarsal cartilage.*

The upper eyelid is as liable to this form of entropium as the lower; very often both are affected together.

In long continued ophthalmia tarsi, or granular or catarrhal or scrofulous conjunctivitis, the tarsal cartilage suffers. It becomes indurated and contracted on its inner surface, whilst it is shortened transversely, or from canthus to canthus; the effect of which is, that the margin of the eyelid is turned in right against the eyeball, and cannot by any traction on the integuments be brought back into its proper position, as in entropium from relaxation. The edge of the eyelid may, indeed, be drawn from contact with the eyeball, but it still remains curved inwards.

In this form of entropium, the margin of the eyelid is often thickened and irregular from hypertrophy of the tarsal cartilage, while the eyelashes are also inverted, constituting trichiasis in addition to entropium.

Allied to the above form of entropium, is that which is sometimes produced by injury of the conjunctiva and cartilage, from the intrusion of lime or other caustic substances into the eye. The contraction attendant on the cicatrization gives rise to inversion of the eyelid with misdirection of the cilia, which is often conjoined with symblepharon.

Treatment.—Ware's operation.—As in this form of entropium the inversion is owing in a great degree to the transverse shortening of the tarsus, Mr. Ware, in order to remedy this, recommended a perpendicular incision to be made through the whole substance of the lid at its temporal extremity or in its middle. In addition to the perpendicular incision, it is sometimes necessary to excise a fold of the integument with the scissors. The perpendicular section of the lid is immediately followed by a separation of the edges of the wound: and it presents an outline similar to that of the letter V; wide at the ciliary margin, and terminating in an acute point in the opposite direction. This wound is gradually filled up by granulation.

Crampton's operation modified.—Supposing the upper eyelid to be the subject of this operation, two perpendicular incisions through its whole substance are made, one near the external canthus, the other near the inner canthus.*

The lid being thus set free, a transverse fold of its skin is then to be removed from near its ciliary margin, and the edges of the gap thus produced brought together by two or three stitches. The threads forming the stitches are to be left long. The eyelid is now to be everted and turned up, and kept in this position for a few days by means of the threads fixed to the forehead by strips of plaister. The perpendicular incisions are thus prevented from uniting by the first intention. They are permitted to heal only by granulation. After the removal of the ligatures, the eyelid is, by the cicatrisation of the perpendicular wound which ensues, gradually drawn into its natural position without being again inverted. During the time the eyelid is kept everted and turned up, it is to be covered with a piece of linen spread with simple cerate.

In cases of entropium of the lower eyelid from transversely contracted tarsus, I have performed the operation in the following manner with perfect success. An incision through the whole thickness of the lid being made perpendicular to its edge near the outer canthus, a piece of the skin of the lid is excised, and then the lid kept in the everted position by fixing on the cheek the end of the threads forming the sutures, which unite the edges of the wound left by the excision of the piece of skin.

When, as often happens, in inveterate cases of the form of entropium under consideration, the operations just described prove ineffectual, recourse must be had to extirpation of the bulbs of the eyelashes as in trichiasis, or amputation of the whole tarsal margin, either by itself or in addition.

Grooving the tarsal cartilage in some cases of entropium and trichiasis is recommended by Mr. Streatfeild, especially when the fibro-cartilage is much thickened, as it is in many of the chronic cases. The operation is performed thus:—A narrow strip of skin and of the subjacent muscle down to the cartilage along and close to the margin of the lid is removed. At the bottom of this linear wound a strip of the cartilage is then removed by two incisions inclined towards each other. By the approximation of the two sides of this groove the edge of the lid and the lashes are everted. (Ophth. Hosp. Repts. Vol. i. p. 121.)

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* The first incision will necessarily wound the lower mass of the lacrymal gland, together with some of the lacrymal ducts; but in the cases in which I have performed the operation, I have not observed any lacrymal fistula or other bad consequence follow. The incision near the inner canthus ought always to be on the temporal side of the punctum, in order to avoid cutting the canalicule.

3rd.—*Trichiasis and Distichiasis.*

Trichiasis is a growing in of eyelashes against the eyeball, the border of the eyelid remaining in its proper position, which circumstance constitutes the distinction between trichiasis and entropium (p. 650).

Distichiasis, again, is merely a variety of trichiasis, in which the misdirected eyelashes are disposed, though not very regularly, in a row distinct from the others which remain properly directed.

The faulty eyelashes in trichiasis and distichiasis are generally the natural hairs which have been made to take a wrong direction, in consequence of cicatrices, &c., of the border of the eyelid. Sometimes, however, they appear to be in part at least of new development.

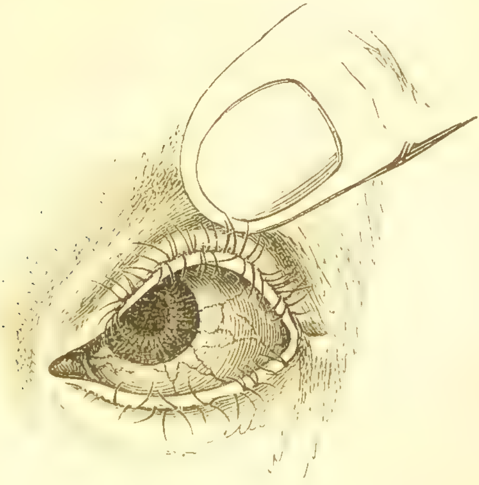

Fig. 159.

Trichiasis may be *partial* or *total*. In the one case, the misdirected eyelashes are confined to a part only of the border of the eyelid; in the other, they spring from it along its whole extent.

The eyelashes of either eyelid separately may be turned in against the eyeball, or the eyelashes of both eyelids may be turned in at the same time. It is not uncommon to find trichiasis or distichiasis affecting the eyelids of both eyes.

The misdirected eyelashes are sometimes very few in number, and so pale and fine, that they are apt to escape notice, so that the inflammation of the eye which they occasion, is attributed to some other cause, unless an exploration of the borders of the eyelids and state of the eyelashes be carefully made as above indicated (p. 4).

The effects on the eye, both *objective* and *subjective*, from the irritation of the misdirected eyelashes in trichiasis, are the same as those above mentioned in entropium (p. 649).

Causes.—Trichiasis and distichiasis are sequelæ of chronic conjunctivitis, and especially those inflammations of the borders of the eyelids which are attended by abscesses and ulcers at the roots of the eyelashes, such as variolous inflammation of the eyelids and ophthalmia tarsi in both its forms.

The co-existence of entropium and trichiasis, and the causes on which it depends, have been noticed (p. 650).

Treatment.—Trichiasis or distichiasis admits of being relieved only by operation.

Evulsion of the misdirected eyelashes.—The mode of performing this operation, and the instrument used, are described in p. 92. It requires to be repeated from time to time as the eyelashes are reproduced. Unless, therefore, the misdirected eyelashes be few in number, this mode of treatment becomes very troublesome.

Excision or cauterization of the skin of the eyelid as in entropium.—Either of these operations may be had recourse to with some advantage in those cases of trichiasis, sometimes met with, in which the eyelashes for a considerable extent along the edge of either lid, instead of being curved upwards in the upper eyelid, and downwards in the lower, are directed perpendicularly, so as readily to cling to the surface of the eyeball.

Destruction of the bulbs of inverted eyelashes by inoculation with the tartrate of antimony.—The parts being put on the stretch over the horn spatula, a lancet or iris-knife is to be entered close to the base of the inverted cilium, in the direction of its growth, to the depth of one-eighth of an inch, and moved about a little, so as to widen the bottom of the wound and cut the bulb. The bleeding having wholly ceased, and the lid being wiped dry, the point of a small probe, or the drilled end of a darning-needle, slightly damped, and dipped in powdered tartrate of antimony, is next to be inserted into the puncture, and held there for a few seconds. The eyelash is now to be seized close to its root, and extracted. Bulb after bulb is to be treated in this way. The inflammation which immediately follows generally subsides in twenty-four hours, but if the operation has been properly performed, a new inflammation supervenes in a day or two, with the formation of small pustules, which, though of very limited extent, proves sufficient to destroy the bulbs.*

Instead of tartrate of antimony, caustic potash has been employed with success for the destruction of the bulbs of the inverted eyelashes. With a needle or iris-knife dipped in the liquid caustic, the tarsal border is punctured to the depth of the hair-bulb, which thereby becomes destroyed.

Extirpation of the roots of the eyelashes.—In inveterate cases of trichiasis, as well as of entropium, or of trichiasis and entropium combined, there is no other resource but destruction of the eyelashes by extirpation of their roots.

In reference to this operation, it is important to call to mind the following anatomical points:—The eyelashes spring from the anterior edge of the free border of the eyelids, and are inserted three or four deep, especially in the middle. The capsules of the bulbs of the eyelashes lie close on the tarsal cartilage under the ciliaris muscle and skin, extending to the depth of about one-eighth of an inch from where the hairs emerge.

The lid to be operated on is to be raised and stretched on the horn spatula-like instrument, represented in the next page (Fig. 160), introduced behind it, and held steadily by an assistant, who at the same time retains the eyelid from slipping away by pressing the eyelashes against the horn spatula with the thumb-nail of the hand holding it.

A better instrument for the purpose is Desmarre's eyelid compressor-forceps, modified by Snellen. (Fig. 161.)

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* Hunter in Edinburgh Monthly Journal of Medicine, 1849.

At the same time that the eyelid is raised and stretched by this instrument, it is compressed, so that bleeding during the operation is prevented. One for the right eye and one for the left is necessary.

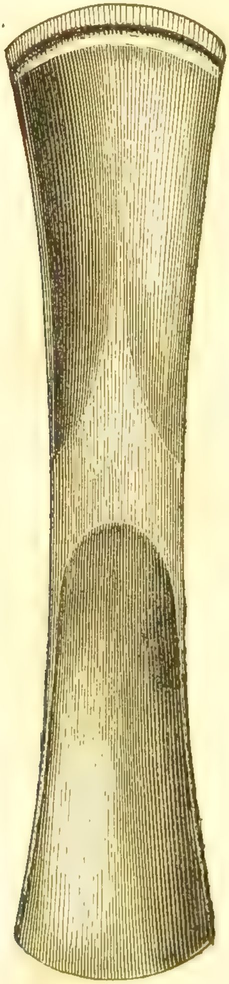

FIG. 160.

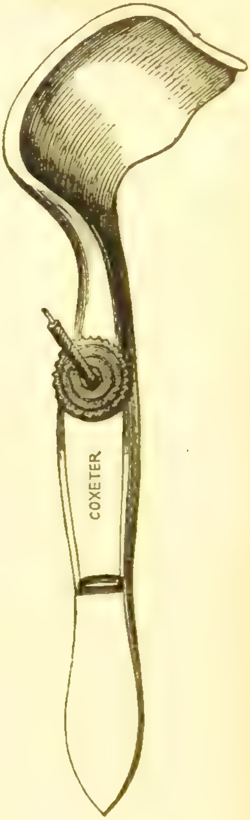

FIG. 161.

The surgeon, then, with a small scalpel, makes an incision, parallel to the border of the eyelid and about one-eighth or one-sixth of an inch from the edge whence the eyelashes issue, through the skin, cellular tissue, and ciliaris muscle, down to the tarsal cartilage. According as it is along the whole border of the eyelid, or along a part only, that the trichiasis extends, and consequently that the extirpation of the roots of the eyelashes requires to be carried, so of course must be the length of the incision. From each end of the incision as now directed, a short one is to be made at right angles to the edge of the eyelid.

The long narrow flap of skin thus marked out is, together with the subjacent cellular tissue, ciliaris muscle, and the bulbs of the eyelashes, to be laid hold of with a toothed or good holding common forceps, and dissected clean from off the tarsal cartilage towards the margin of the eyelid. The surface of the tarsal cartilage may even be shaved off.

It is scarcely necessary to say that in this dissection injury of the lacrymal point and canalicule must be carefully avoided.

The detached flap, comprising skin, cellular tissue, muscular fibres, and bulbs of eyelashes, is now to be cut away with the scissors along the margin of the eyelid.

During the operation, the blood oozes out in very considerable quantity, and requires to be assiduously taken up with a sponge by an assistant, in order that the operator may see that no bulbs are left unremoved. The compressor-forceps above described prevents this bleeding.

If any bulbs still remain, they will present themselves as black points, and thus be readily discovered. They are to be laid hold of with the forceps and removed with the scissors. After this, to insure still more the removal of all the bulbs, the bottom of the wound should be touched with the powdered tartrate of antimony or caustic potash, and left to suppurate.

If the bulbs have not been all removed or destroyed, it will be found that the part has scarcely healed, when a hair or two will be found here and there sprouting out again.

If the case be one of entropium and trichiasis combined, it is advisable to commence the operation by making two perpendicular incisions through the whole thickness of the border of the eyelid, as in Crampton's operation for entropium (p. 653). Indeed this might always be done, as thereby the supply of blood to the part operated on is in a great measure cut off, and the hindrance to the successful dissecting out of the bulbs of the eyelashes from the oozing of blood diminished.

When the tarsal cartilage is much thickened and indurated, it should be shaved down with a fine sharp scalpel to the natural degree of thickness.

LAGOPHTHALMOS.*

This name is given to a constant open state of the eyelids, the consequence of which is, that the eye is, as in ectropium, exposed to the entrance of foreign particles and other causes of irritation.

There are three principal forms of lagophthalmos, depending on very different causes, viz. :—

1st. Paralysis of the orbicularis muscle, allowing of the unrestrained action of the levator palpebræ.

2nd. Retraction from cicatrices, and adhesions of the skin of the upper eyelid.

3rd. Congenital imperfect development of the eyelid.

1st.—*Lagophthalmos from paralysis of the orbicularis palpebrarum.*

This is one merely of several symptoms of paralysis of the portio dura of the seventh pair. The paralysis of the orbicularis may be so complete that the upper eyelid is immovably retracted ; but in general it is not so complete, the eyelids still admitting of being approximated, though not accurately closed.

Besides the retraction of the upper eyelid, the border of the lower is somewhat fallen away from the eyeball. The lacrymal papillæ and puncta being thus no longer duly directed to the lacus lacrymalis, the tears are not absorbed and drawn off into the nose, but fall down over the cheek.

Causes of paralysis of the portio dura.—Paralysis of the portio dura may be owing to cerebral disease, or to some affection of the nerve itself, either in its passage through the aqueduct of Fallopius, or at its exit from the stylomastoid foramen.

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* Oculus leporinus, or hare's eye, so called from its having been supposed that hares sleep with their eyes open.

Affection of the nerve in its passage through the aqueduct of Fallopius often depends on caries of the osseous walls of the tympanum.*

The affection of the nerve at its exit from the stylomastoid foramen may be owing to pressure on it by an enlarged lymphatic gland or other tumour.

Sometimes the affection of the nerve would appear to be of a rheumatic nature, like what is sometimes the case with paralysis of the nerve of the third pair (p. 584).

Treatment.—This resolves itself into the treatment of the cerebral disease, disease of the ear, or enlarged lymphatic gland or tumour. In cases in which the paralysis of the nerve seems to have arisen from cold, and is altogether uncomplicated with disease of the ear or swelling at the angle of the jaw, the plan of treatment above indicated for rheumatic paralysis of the nerve of the third pair is equally applicable (p. 584).

A woman, æt. 33, has for the last ten months been subject to throbbing pain across the forehead, and especially in the temples. Health otherwise good during that time.

A month last Saturday night, stood for an hour and a half in the street in the cold. When she rose next morning, felt a twitching and quivering of the upper lip on the right side, which continued at intervals for three days.

Some days after that the right eye became weak and watery.

Last Saturday morning, she found that on attempting to blow away dust or the like, she was unable to do so. She at the same time felt her mouth drawn to the left side.

On examination the right cheek was observed to be collapsed, the mouth drawn to the left side, especially in speaking. She can shut the right eyelids, but not closely, and feels herself unable to compress the eyeball with the eyelids. The edges of the right eyelids somewhat red, and the palpebral conjunctiva injected. The right eye watery from the puncta lacrymalia not being duly directed towards the lacus lacrymalis.

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* See Author's article—Ear and Hearing, Diseases of, in the Cyclopædia of Practical Surgery.

2nd.—*Lagophthalmos from organic contraction or adhesions of the eyelids.*

The organic shortening or retraction of the eyelids producing lagophthalmos, usually depends, like that producing ectropium, on the contraction attendant on cicatrisation of a burn or other injury ; or on the skin of the eyelid being drawn into adhesion with the edge of the orbit in consequence of carious ulceration.

Treatment.—This form of lagophthalmos can only be remedied by one or other of the operations above described for ectropium, the choice of the operation being determined by the circumstances of the case.

Of course, when the retraction of the eyelid depends on caries of the edge of the orbit, no operation should be had recourse to till this is cured.

Figure 1, Plate IX., represents an eye affected with *coloboma palpebræ et lagophthalmos*, on which I performed the operation described below.

The patient, a gentleman about twenty years of age, was introduced to me by my colleague Dr. Hillier. The distortion of the eyelids and the destruction of the eyeball were the result of an injury suffered in childhood, from the bursting of a soda-water bottle.

Figure 2, Plate IX., represents the eye after the operation.

Figure 3, Plate IX., the same when an artificial eye had been fitted in.

a. Operation on the Upper Eyelid.

The lines *a* and *b*, in Figure 162, indicate the course of the incisions, which were made with a pair of scissors through the whole thickness of the eyelid. The angular flap *c*, marked out by these incisions, together with a frenum of conjunctiva between it and the eyball, retracted somewhat; while the segments of the eyelid, on either side, admitted of being brought down and united by two sutures, in the manner represented in Figure 163. Preparatory to uniting the wound, the apex of the flap *c* was pared, to make it pointed and raw.

b. Operation on the Lower Eyelid.

About ten days after the operation on the upper eyelid, that on the lower was performed on the same principle as indicated by the lines in Figures 162 and 163.

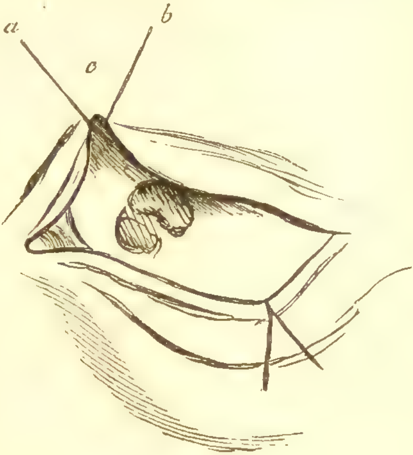

Fig. 162.

The operation which I have thus briefly described is, I believe, quite new in principle. No plan I am aware of, hitherto practised, could have effected the purpose so naturally, simply, and completely.

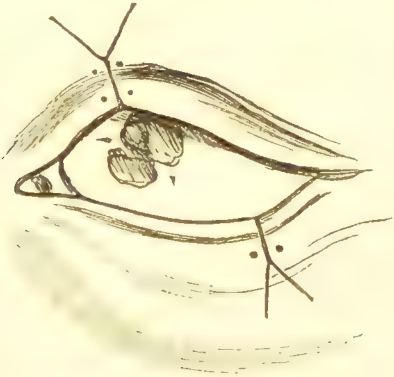

Fig. 163.

Some time after the operation on the eyelids, it was found necessary for the better fitting in of an artificial eye to diminish the size of the stump of the eyeball by abscission.

3rd.—*Congenital lagophthalmos.*

Congenital lagophthalmos is dependent on imperfect development of the upper eyelid, and is often a part merely of general *microphthalmos.*

BLEPHAROSPASM.

Twitching or quivering of the eyelids.—Morbid nictitation.

A frequent twitching or quivering of the eyelids, though felt by the patient himself, may not be very apparent to another person. Sometimes, however, it is not only the orbicularis, but also other muscles of the face supplied by the portio dura which are affected; in which case the twitchings are very evident to the observer. This is felt by the patient to be very annoying, especially as he usually is at the same time of a nervous temperament.

Winking several times in immediate succession every now and then may be owing to the irritation of some foreign particle in the eye, or slight inflammation. In which case, on the removal of the cause the effect will subside.

Sometimes, however, the morbid nictitation is an habitual infirmity, allied in its nature to twitching and quivering.

The *spasmodic closure* of the eyelids which attends intolerance of light or is excited by the intrusion of a foreign particle into the eye, is to be distinguished from the blepharospasm sometimes met with as an exaggerated degree of the two preceding affections.

Treatment.—Action on the stomach and liver followed by tonics, with attention to diet.

The too free use of intoxicating liquors, if indulged in, ought to be abandoned.

The application of a leech or two, followed by counter-irritation between the angle of the jaw and the mastoid process, is sometimes found decidedly advantageous.

The tonic which has been found most useful is iron in some such form as the ammonio-citrate combined with valerian, or, according to the experience of Dr. Hays of Philadelphia, the valerianate of zinc.

PTOSIS, OR FALLING DOWN OF THE UPPER EYELID.*

Ptosis is the opposite of lagophthalmos, the upper eyelid hanging down over the eye, and not admitting of being raised for the exercise of vision.

There are four principal forms of ptosis.

1st. Ptosis from paralysis of the nerve of the third pair.

2nd. Ptosis from injury of the levator palpebræ muscle.

3rd. Ptosis from extension and relaxation of the skin or of the whole substance of the eyelid.

4th. Congenital ptosis.

1st.—*Ptosis from paralysis of the nerve of the third pair.*

The nature of this form of ptosis has been already noticed (p. 580).

Treatment.—If the paralysis of the nerve of the third pair be confined to one side, and resist the treatment above indicated, nothing more can be done; if, however, the nerve on both sides be affected, and double ptosis therefore exists, the application of a strip of plaister, or some such contrivance, must be had recourse to, to retain the upper eyelid on one side open, in order that the person may see to move about.

A degree of ptosis comes on naturally from sleepiness. A woman affected with incomplete paralytic ptosis was always unable to open her eyes after a bad night's rest. Being subject to sleeplessness, she was much benefited by soporifics.

Another patient—a man—had ptosis in a half degree in the daytime, but complete at night. The ptosis came on suddenly in the complete form two months before. Never had double vision.

2nd.—*Ptosis from injury of the levator palpebræ muscle.*

In wounds of the upper eyelid, the levator muscle may be divided, or otherwise so injured, as to be rendered unfit to exercise its function; the result of which is ptosis.

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* Blepharoptosis.

After healing of the wound, the function of the muscle may become re-established by re-union, in which case, the ptosis disappears. This may, however, not take place, especially if the muscle be much torn.

For the rectification of ptosis thus occasioned, an operation has been performed by Mr. Hunt, of Manchester, which consisted in the removal of a transverse fold of integument from the eyelid, of such an extent and from such a place, that when the edges of the wound became united, the eyelid was attached to that portion of the skin of the eyebrow upon which the occipito-frontalis acts; so that the action of this muscle was substituted for that of the levator palpebræ.

3rd.—*Ptosis from extension and relaxation of the skin, or of the whole substance of the eyelid.*

Extension and relaxation of the skin of the eyelid occasioning ptosis may be the result of long-continued œdematous swelling of the parts, and the like, but it sometimes occurs in old persons without any evident cause.

This form of ptosis may in general be remedied by the excision of an elliptical piece of skin as above directed for entropium (p. 652, et seq.).

Ptosis from extension and relaxation of the whole substance of the eyelids, I have seen as a sequela of purulent ophthalmia in which bluestone and other caustics had been much abused in the attempt to remove the granulated state of the conjunctiva.

In such a case, the excision of a wedge-shaped piece of the eyelid has been recommended, in order to diminish its length transversely. To this, if necessary, might be added the excision of an elliptical piece of skin, as above directed, in order to shorten the lid vertically. But such an operation should of course not be had recourse to unless the eye has otherwise pretty well recovered.

4th.—*Congenital ptosis.*

Ptosis sometimes occurs congenitally, owing to an imperfectly developed state of the levator palpebræ muscle. I have seen the defect in both father and child.

If the ptosis is so complete that the eye cannot be opened for use, some such operation as that above mentioned under the head of ptosis from injury may be tried.

Cases occur in which there is no defect of the levator muscle, but in which the skin of the eyelid is congenitally so relaxed that the eye cannot be opened. Retrenchment of the superabundant structure is here indicated.

Epicanthus.

This name has been coined to designate a congenital peculiarity, which consists of a fold of skin extending from the side of the root of the nose over the inner canthus of the eye. The free edge of the fold is crescentic, and its extremities are lost in the skin of the upper and lower eyelids. Dr. Ammon, to whom we are indebted for the name, has performed an operation for the obliteration of the folds, which consists in the vertical excision of an elliptical piece of skin from over the root of the nose on a level with the epicanthus, and then bringing the edges of the wound together by suture. It is seldom, however, that epicanthus impedes the movements of the eyelids so much as to render an operation necessary. The folds, moreover, usually disappear as the child's nose increases in prominence.

Epicanthus has been imagined to dispose to squinting, and this has been considered a reason for operating. I have seen cases in which the child squinted, but also many in which there was no squint.

I have in short never seen any necessity for operating on the epicanthus.

SECTION III.—MORBID CONNEXIONS OF THE EYELIDS.

1st.—*Anchyloblepharon.*

This, which is not of very common occurrence, is an adhesion of the eyelids to each other by their borders.

Anchyloblepharon is distinguished into *mediate* and *immediate*, according as the adhesion is through the medium of a false membrane, or without any intervening substance; and into *partial* and *total*, according as the borders of the eyelids are united in part only, or in their whole extent.

In partial anchyloblepharon the adhesion is usually towards the outer angle. In total anchyloblepharon, the edges of the secondary fissure at the inner canthus are seldom or never adherent, so that there is an opening at the inner angle leading into the oculo-palpebral space of the conjunctiva.

Anchyloblepharon is either congenital or acquired.

Congenital anchyloblepharon is generally total, and either mediate or immediate, and often co-exists with imperfect development of the eyeball. An opening between the eyelids at the inner canthus commonly exists; sometimes an opening at the outer canthus has been met with; in other cases no opening at either canthus, but one in the middle.

Congenital anchyloblepharon is somewhat analogous to the closed eyelids presented by puppies, kittens, &c., that are *born blind*, as it is called. It is, however, persistent.

Acquired anchyloblepharon is generally the consequence of excoriations by burns or escharotics, in which case it is often complicated with symblepharon, or adhesion of the lids to the eyeball, or of such inflammations as are attended with excoriation and ulceration of the tarsal borders, and generally only partial.

Partial anchyloblepharon is to be distinguished from *phimosis palpebrarum*, which is properly contraction of the palpebral fissure from transverse shortening of the borders of the eyelids, accompanied by contraction of the conjunctiva (pp. 109, 261).

Supposing the eye otherwise sound, the effect of anchyloblepharon is of course to impede or wholly prevent the exercise of vision according as it is partial or total: but very often, anchyloblepharon is complicated with symblepharon, or adhesion of the eyelid to the eyeball, or with some other defect of the latter, viz., such as may arise from the same injury or inflammation, which gave occasion to the adhesion of the eyelids, or, in the case of congenital anchyloblepharon, imperfect development of the eyeball.

Prognosis and treatment.—The treatment consists in separation of the adhesion with the knife; but in cases of total anchyloblepharon, it is necessary, before proceeding to operate, to direct attention to the state of the eyeball as regards prominence and firmness, and whether or not the case is complicated with symblepharon, or adhesion of the eyelid to the eyeball. The degree of sensibility to light ought also to be had regard to as an indication of the condition of the eyeball.

To determine whether or not the case is complicated with symblepharon, or adhesion of the eyelid to the eyeball, the united eyelids are to be pinched up into a fold, and the patient desired to move the eyeball about and to make efforts as if to open and shut the eye. During this, the attention of the surgeon is to be directed as to whether the eyeball moves freely or not behind the eyelids. The point may be also ascertained by passing a probe through the opening at the inner or outer angle, if such exist, and observing whether or not it can be freely moved up and down in the oculo-palpebral space.

The operation for partial anchyloblepharon is performed by passing a director behind the part where the borders of the eyelids adhere, whilst an assistant stretches the upper eyelid upwards, and the lower downwards, and separating them with a scalpel, taking care, in the case of immediate union, not to cut the proper substance of the tarsus either of the one or other eyelid. If the anchyloblepharon be mediate, the false membrane is to be detached first from the border of the lower eyelid, and then from that of the upper, a scalpel or scissors being the instrument employed according to the thickness and connexions of the false membrane.

In the case of total anchyloblepharon, if there is an opening at the inner angle, a director or probe is to be passed through it behind the united eyelids, and their separation effected in a manner similar to that just indicated. If, however, there is no opening, the united eyelids are to be pinched up into a vertical fold, drawn from the eyeball, the assistant taking charge of the upper eyelid, the surgeon himself the lower, and the united edges separated at the part. Through the opening thus made the director is passed, and run along, first to the inner angle, and the adhesion divided in that direction, and then to the outer angle, and the adhesion divided in that direction.

The operation which has now been described, it will be observed, is of comparatively easy performance, but the tendency to re-adhesion constitutes the great obstacle to a successful issue, especially in cases in which the anchyloblepharon has arisen from burns and the action of escharotics.

To prevent reunion, the eyelids should be frequently drawn from each other after the operation, and the raw borders smeared with tutty ointment, until cicatrization takes place. What is very likely to prove useful, is to promote union between the skin and conjunctiva at the external angle, by means of a suture.

2nd.—*Symblepharon.*

This is adhesion of the conjunctival surface of one or both eyelids to that of the eyeball. The cornea is generally more or less involved in the adhesion. It may be either *mediate* or *immediate*, *total* or *partial*, and may exist in complication with anchyloblepharon.

Symblepharon is usually the consequence of injury of the conjunctiva from the action of escharotics intruded into the eye (p. 109), or ulceration of the conjunctiva.

The contraction of the conjunctiva, with obliteration of the palpebral sinuses, above referred to under the head of Cuticular Conjunctiva (p. 261), has been called *symblepharon posterius*, but it differs from the symblepharon under consideration as essentially as phimosis palpebrarum, with which it generally co-exists, does from anchyloblepharon (p. 668).

Prognosis and treatment.—The morbid adhesion between the eyelid and the eyeball may be readily separated by the knife, but re-establishment of the adhesion is as prone to take place as in anchyloblepharon, or more so. Even in partial mediate symblepharon, the bands or fræna have been generally found to be reproduced.

In some cases of this sort, better success may be obtained by first cutting the band or frænum at its connexion with the eyeball, and uniting the wound of the ocular conjunctiva with a stitch or two of fine thread, the band or frænum being left in connexion with the eyelid, and only removed, if necessary, after the union of the wound of the ocular conjunctiva.

To permit of the approximation of the edges of the wound by sliding of the conjunctiva, according to the principle of the operation by transposition for ectropium, above described at p. 627, that membrane may be incised at some appropriate distance and place. But this, as well as transplantation of the conjunctiva, presupposes the favourable condition of a circumscribed adhesion with a great extent of adjacent sound conjunctiva.

SECTION IV.—TUMOURS, CANCER, ETC., OF THE EYELIDS AND EYEBROWS.

1st.—*Phlyctenulæ on the borders of the eyelids, from obstruction of the Meibomian apertures and retention of the secretion.*

This state, which has been above noticed (p. 9), gives rise to some uneasiness in the part, especially when the eyelids are moved. The film which forms the walls of the phlyctenula will give way of itself, and the accumulated secretion be allowed to escape; but removal may be at once effected by lacerating the phlyctenula with the point of a pin.

2nd.—*Meibomian concretions.*

Concretions sometimes form apparently in the Meibomian glands, and are seen shining through the palpebral conjunctiva on everting the eyelid. Sometimes they project on the surface of the conjunctiva, acting thus as a cause of irritation to the eye. The concretion may be calcareous or sebaceous.

The removal of such a concretion is effected by dividing the conjunctiva over it, with the point of a lancet and turning it out with a Daviel's spoon.

I have been sometimes applied to by patients complaining of a feeling as if some foreign body were in the eye, and on examination have discovered a small mass of sebaceous matter, like what may be squeezed out from one of the sebaceous glands of the nose, only somewhat firmer and clearer, contained in a follicle in the conjunctiva over the tarsal cartilage and protruding at the surface. This sebaceous mass, like the contents of a sebaceous gland of the skin, was readily pressed out.

3rd.—*Enlargement and induration of the Meibomian glands.*

When the Meibomian glands are thus affected, they are felt under the skin like strings, besides forming prominences towards the borders of the eyelids.

Alteratives and tonics generally, and friction with camphorated mercurial ointment locally, constitute the only admissible treatment.

4th.—*Vesicles or phlyctenulæ on the cutaneous surface of the eyelid near its margin.*

Vesicles or phlyctenulæ, containing a watery fluid, are sometimes met with single or several together, and of a size from that of a mustard seed to the size of a pea. The evacuation of the fluid by a puncture with a lancet is sometimes sufficient for the removal of these vesicles; if not, the vesicle is to be snipped off with the scissors.

5th.—*Sycosis of the edge of the eyelid.*

This is a softish fleshy-like growth, sometimes shooting out with a sharp edge from the margin of the eyelid. It is to be snipped away with the curved scissors, and the part afterwards repeatedly touched with the sulphate of copper.

6th.—*Warts on the eyelids.*

Warts are not uncommon on the cutaneous surface of the eyelids or on their border.

If pedunculated, they may be removed by ligature, or at once snipt off with the scissors. The root is then to be touched with strong acetic acid or lunar caustic. If they have a broad base, their removal may be effected by the escharotics alone.

7th.—*Horny-like excrescences connected with the skin of the eyelids.*

One of the minute sebaceous follicles of the skin of the eyelids, especially of the lower, may become enlarged, and give out a morbid secretion, which, hardening as it is produced, does not fall away on being thrust out by successive additions, but forms the horny-like excrescences under consideration.

The portion of skin in which the excrescence has its root, is to be snipped off in a fold with the scissors.

8th.—*Milium.*

A small white pearly-looking tumour, of about the size of a pin's head, called *milium*, often presents itself in greater or less numbers in the skin of the cheeks and eyelids, situated apparently immediately underneath the epidermis, which they raise up and through which they shine.

Composed of a comparatively thick capsule without opening, in which is contained a sebaceous-looking matter, milia are quite different from enlargements of the common sebaceous follicle, produced by accumulated secretion.

The bodies in question are in their natural course thrown off by the giving way of the epidermis covering them, and may be succeeded by new ones. They thus appear to be of the same nature, as dehiscent glandular cells of the simplest kind.

Their removal, when required, is best effected by carefully scratching through the epidermis covering them with any fine-pointed instrument, taking care not to scratch so deep as to cut the capsule, and squeezing the body out of its nidus between the thumb nails. If the capsule be wounded, it may remain while its contents only escape. The body, when turned out whole, exactly resembles a minute pearl.

9th.—*Thickwalled encysted tumours.**

Large tumours—of the size of a horse-bean, or even greater—but apparently of the same nature as the miliary ones just described, are sometimes met with, especially in children, imbedded in the skin and subcutaneous cellular tissue of the eyelids.

The capsule part of the tumour is white, very thick, sometimes of considerable almost gristly consistence, and rough and tuberculated on its surface.

The removal of such a tumour is most easily effected by dividing it, as well as the investing integument, with the stroke of a lancet, and then by pressure squeezing out the halves of the thick cyst from their nidus. The wound left quickly heals. If the sebaceous contents merely have been pressed out, and the thick wall of the cyst left, as it sometimes is, the wound does not heal, but degenerates into an ill-conditioned ulcer, which remains until the cyst is removed.

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* Albuminous tumour ;—Molluscum contagiosum ;—Glandiform tumour.

These tumours sometimes occur in considerable number, and of different sizes, in the eyelids, eyebrows, forehead, and cheek.

10th.—*Chalazion,* or tarsal tumour.*

This tumour is situated in the substance of the tarsal cartilage, usually some little way from the margin of the eyelid. It sometimes causes considerable elevation of the skin, but generally it occasions no marked appearance externally. On everting the eyelid, the conjunctiva at the place is observed to be livid red, and elevated, but sometimes depressed in the middle. As the tumour increases, the conjunctiva becomes thin, and at last gives way, when a small fungus-like substance rises from the opening.

The tumour consists of a gelatiniform fibrinous matter not encysted, but simply contained in a cavity it has formed for itself by accumulating in the substance of the tarsal cartilage. Examined under the microscope, the gelatiniform fibrinous matter is seen to contain cells in various degrees of development, and to be interspersed with a few capillary vessels.

Suppuration sometimes takes place in the tumour.

Treatment.—If, as is frequently the case, the patient be dyspeptic, by improving the state of the digestive organs. the tumour may be arrested in its progress and even altogether dispersed. Locally, friction with camphorated mercurial ointment may be employed.

If the tumour, however, has already become large, and presses disagreeably on the eyeball, it ought to be removed. The operation consists in everting the eyelid. making a free incision into the tumour, and pressing out its contents so far as they admit of it; what remains is to be broken up and scooped out by means of Daviel's spoon introduced through the wound.

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* Fibrinous tumour, Mackenzie.

When more prominent externally than internally the incision may be made through the skin over the tumour parallel to the margin of the eyelid.

It may happen that two tumours lie close together, and one only be evacuated by the incision. Should this prove to be the case, the incision is to be made into the second tumour also, and its contents pressed out. Of two tumours, one may be more prominent internally, the other externally.

A chalazion giving way, a fungus-like excrescence, as above mentioned, arises from its bottom. This may continue without farther trace of the chalazion.

An incision being made on each side of its base, it is to be cut out by the root with a pair of curved scissors.

11th.—*Encysted tumour.*

Encysted tumours, sometimes congenital, are occasionally met with in the eyelids, especially the upper, towards the temporal side. They are situated under the orbicularis palpebrarum, and are often adherent to the periosteum of the margin of the orbit. The cyst is thin but firm, and the contents, a sebaceous or glairy matter, sometimes mixed with hairs.

For the removal of such tumours, the following general directions only can be given:—

1st. The external incision should be free, and in the direction of the orbicularis palpebrarum.

2nd. The cyst should be dissected out entire, if possible. At any rate, it must all be extirpated. If any part of it is left, which without care might happen in regard to that part of it adhering to the bone, the wound will not heal, and disease and exfoliation of the bone may take place.

12th.—*Hydatids in the cellular substance of the eyelids.*

Dr. Mackenzie mentions a case of swelling over the temple and zygoma, from which, by puncture from within the mouth, a glairy fluid and a number of hydatids were discharged. After this an abscess formed in the upper lid, in the pus evacuated from which there were contained several hydatids.

13th.—*Nævus maternus and aneurism by anastomosis in the region of the eyelids.*

The skin of this region, as well as that of any other part of the body, is occasionally found to be the seat of that form of nævus, called *mole*, in which a circumscribed part of the skin is thickened, of a brown colour, and covered with hair.

Nævus or aneurism by anastomosis also sometimes implicates the eyelids.

The various methods of treating nævi or aneurism by anastomosis which have been adopted, are:—vaccination—escharotic and irritant injections into the tumour—incision of the vessels within the tumour—seton—ligature.

By subcutaneous ligature, I have obtained obliteration of large vascular nævi of the upper eyelid.

Another plan is to draw through the tumour a mesh of thread dipped in a solution of perchloride of iron. By the coagulation of the blood, the tumour becomes solidified, and is eventually absorbed.

Superficial nævi, I have treated by the application of lunar caustic.

14th.—*Scirrhoid callosity of the eyelids.*

A hard tuberculated warty-like degeneration of the eyelid, commonly the lower, at the tarsal border to a greater or less extent, traversed by varicose vessels, and ending in ulceration, sometimes occurs, especially in old people. Though resembling, it is not of the nature of scirrhus.

If not irritated, it may remain stationary. Sometimes, however, it causes so much irritation to the eye, and produces so much deformity, that the patient seeks for its removal by operation.

The operation consists simply in the amputation of the diseased part.

15th.—*Epithelial Cancer of the eyelids.*[*]

Epithelial cancer commences more commonly in the lower eyelid than in the upper, and first manifests itself as a small indurated wart or tubercle, next the cheek, towards one or other angle, over which the skin may be otherwise natural, except that it is pervaded by enlarged veins, and which is little or not at all painful. This tubercle is, perhaps, followed by others.

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[*] Epithelioma.

This stage of the disease—*the stage of induration*—after remaining for an indefinite time, is succeeded by *ulceration.* The ulcer is smooth and destitute of granulations, and the scanty discharge from it consists of a viscid sanies. The edges of the ulcer are knotted and irregular, but the surrounding skin is natural. Heat and lancinating pain in the part may now be complained of. The ulceration may be arrested for a time, and again proceed, or while it stops at one part it goes on at another.

Though the ulceration may eventually eat away not only the whole eyelids, but also the neighbouring parts, it does so very slowly, perhaps only in the course of years.

In the progress of the disease, the eyeball may be destroyed by ulceration and bursting of the cornea with evacuation of the humours, but this appears to be the effect rather of common inflammation of the eyeball, from the exposure to which it is subjected by the loss of its protecting parts, than of extension of the cancerous disease.

Inconsiderable suffering in general attends the stage of ulceration, but when nerves are exposed, or when the eyeball bursts, there is, of course, severe pain.

The neighbouring lymphatic glands do not, at least not until an advanced stage of the disease, become swollen, and the general health does not suffer.

Cancer of the eyelids, which is an uncommon disease, does not occur before the middle period of life; in which respect it is distinguished from lupus.

From syphilitic ulceration of the eyelids above described, cancerous ulceration may be distinguished by the slowness of its progress, and the natural state of the surrounding integuments, together with the history of the case.

Treatment.—While the disease is as yet circumscribed, its removal may be attempted either by escharotics or extirpation.

Escharotic Treatment.—The following case of cancerous ulceration close to the inner canthus, treated with sulphate of zinc paste as recommended by Dr. Simpson of

Edinburgh, has been published by Dr. Mackenzie in the Ophthalmic Hospital Reports for April, 1859.

Having driven off by heat the water of crystallisation of a few grains of the sulphate of zinc, and reduced the residuum to a fine powder, he mixed it with glycerine so as to form a thick tenacious paste. Taking a little of this on the point of a bit of stick, he applied it over the scab and over the hard edges of the ulcer, and covered the part with dry lint.

Next day, he found that the application had given very little uneasiness; but that it had acted in destroying almost entirely the hard edges of the sore, and left the whole of its surface free from scab and of a florid healthy colour.

Two or three times subsequently, Dr. M. covered the edges again with the zinc paste; after which, he left the wound to cicatrise under the application of dry lint. The result was that in less than two months from the commencement of the treatment, healing had taken place with a firm and healthy-looking cicatrice.

Extirpation.—In removing the affected parts with the knife, a portion of the healthy structure immediately around must be included.

At the same time that the morbid structure is removed, it would be proper to transplant a portion of skin from the neighbourhood in order to fill up the gap and thus preserve, if possible, a covering for the eyeball.

Antiphlogistic and anodyne remedies are often found useful, not only in palliating symptoms, but even in retarding the progress of the disease.

16th.—*Melanosis of the eyelids.*

The eyelids and conjunctiva are sometimes implicated in melanosis, but it is not necessary to go particularly into the subject.

17th.—*Phtheiriasis of the eyebrows and eyelashes.**

Pediculi on the eyebrows or edges of the eyelids keep up a state of chronic inflammation, and cause intolerable itching.

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* See a case of Mr. Streatfeild's, reported and illustrated—"Ophthalmic Hospital Reports," Vol. II. p. 125.

Treatment.—After as many of the eyelashes have been plucked out as are loose enough to yield to the force exerted by means of the finger and thumb, the eyebrows, and edges of the eyelids, are to be smeared with some mercurial salve, such as the strong red precipitate or citrine, twice a day. After which, care is to be taken to dislodge the insects from the eyebrows by means of a fine comb; from the eyelashes, by means of a forceps, or the eyed end of a darning needle.

CHAPTER VIII.

SECTION I.—DISEASES OF THE CONJUNCTIVA.

1st.—*Pterygium.*[*]

THIS is a vascular and thickened state of a circumscribed portion of the conjunctiva of a triangular form, the apex corresponding to the cornea, on which it encroaches to a greater or less extent; the base corresponding to the circumference of the eyeball. The connection between the portion of the conjunctiva implicated and the subjacent sclerotica, continues as loose as in the natural state.

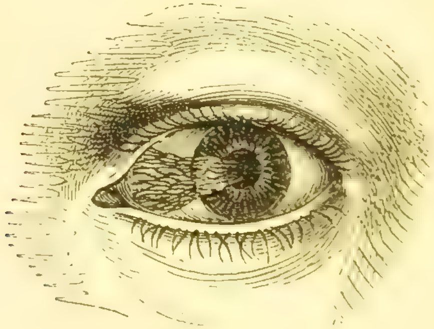

FIG. 164.

Pterygium has its seat generally on the nasal side of the eye, in which case its base corresponds to, and is incorporated with, the semilunar fold, but that it is not in its nature an extension of that fold of conjunctiva is

[*] Web.

proved by the circumstance, that pterygium sometimes occurs on the temporal side, and even, though more rarely, on the upper or lower side of the eye.

Moreover, the disease appears to begin by the formation of what ultimately forms its apex, close to the edge of the cornea, before any thickening or unnatural vascularity of the conjunctiva is observable.

The disease is of consequence only when it implicates the conjunctiva corneæ so far that the vascularity and thickening extend to the middle of the cornea, and obstruct the pupil.

Both the nasal and temporal sides of the same eye are sometimes the seat of pterygium. Cases, it is alleged, have been met with in which pterygium existed not only on the nasal and temporal, but also on the upper and lower sides of the same eye.

Two degrees of pterygium occur, viz., *pterygium tenue vel membranosum*, and *pterygium crassum vel musculosum;* the former thin and semi-transparent, the latter thick and fleshy-looking.

Causes.—Nothing certain has been made out on this head. The subjects of pterygium are generally old persons. It sometimes takes its origin in chronic inflammation of the conjunctiva. The affection has been most frequently met with in labourers whose work exposed them to the entrance of mortar and stone dust into the eye, and in persons who have been long resident in hot climates. Dr. Mackenzie mentions that he has seen a particle of gunpowder, which had been lodged for years under the conjunctiva, at last cause pterygium.

Diagnosis.—Partial mediate symblepharon is apt to be confounded with pterygium. Indeed, many of the cases which have been described and delineated as examples of superior and inferior pterygium, appear to be examples rather of partial mediate symblepharon.

Prognosis.—The morbid state of the conjunctiva under consideration, is not disposed to disappear spontaneously, but it may remain stationary or be long before it extends so far on the cornea as to interfere with vision.

Treatment.—Pterygium may sometimes be removed by frequently touching it with the nitrate of silver solution or with vinum opii. If, however, it does not yield to this treatment, and if it has extended so far on the cornea as to obstruct vision, its removal by operation becomes necessary.

Operation for the removal of pterygium.—The patient being seated as for the operation for cataract, and both eyelids secured by an assistant, or held apart by the spring-wire speculum, the surgeon, while the patient turns the eye outward, if the pterygium be on the nasal side, with a hooked forceps seizes the pterygium about its middle, and, whilst keeping it raised from the surface of the sclerotica, passes a cataract or iris-knife with the edge towards the cornea, and one of the flat surfaces of the blade towards the sclerotica, behind it, and detaches it from the sclerotica by cutting outwards as far as the margin of the cornea, where the knife is to be made to cut itself out. Still keeping hold of the pterygium with the forceps, he now with the same knife, or with a pair of curved scissors, separates the pterygium towards its base, where it is to be cut away without encroaching too near the semilunar fold, if it be an internal pterygium.

Instead of such an extensive removal, it will be found, in most cases, sufficient to seize the pterygium with the forceps near the cornea, in such a manner as to raise it up in a fold; and then, with a pair of curved scissors, to snip away the apex part of it.

The base part of the pterygium does not require to be interfered with. The semilunar fold, especially, must be left untouched.

2nd.—*Pinguecula.**

This is a small whitish-yellow tumour, from the size of a pin's head to that of a small pea, in the sclerotic conjunctiva and subjacent cellular tissue, close to the margin of the cornea on its nasal or temporal side. It is so called from its being supposed to be a deposition of fat, though erroneously, as shown by Weller, who found it to be of an albuminous nature. One or two of the rectal vessels, enlarged and varicose, usually run into it.

Pinguecula, which is of very common occurrence towards the middle period of life, can scarcely be viewed as morbid, inasmuch as it occasions no inconvenience of any kind. When its removal is required, it is only for the sake of appearance. Being seized with a hooked forceps, and raised, the tumour and a small portion of the surrounding conjunctiva are to be snipped off transversely with a pair of curved scissors.

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* Pterygium pingue.

In a case of large pinguecula, I observed that it was pinched up between the edges of the eyelids when the latter closed. This led me to examine other cases, when I found that the pinguecula always occupies that part of the conjunctiva which, when loose, is liable to be pinched between the borders of the eyelids. It is probable, therefore, that pinguecula owes its origin to the constant slight irritation thereby occasioned.

3rd.—*Congenital sclerotico-conjunctival tumour.**

This is a small congenital tumour analogous to those of the skin called *moles*, occasionally met with on the white of the eye, close to the margin of the cornea, on which it perhaps slightly encroaches. The tumour here delineated, which I removed, was composed of pretty dense tissue, similar to that of the sclerotica, with which indeed it was incorporated, covered with conjunctiva, in which the small hairs growing from it had their roots. Similar tumours, but without hairs growing from them, are met with. In a case mentioned by Mr. Wardrop, hairs did not appear until the time of puberty.

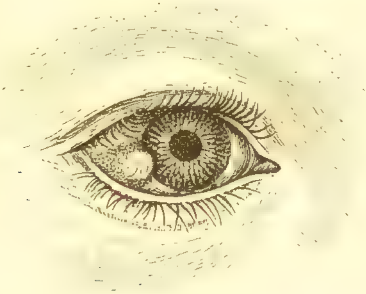

FIG. 165.

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* Trichosis bulbi is a name which is applicable to the tumour only when hairs are growing on it.

The tumour being not only a blemish, but sooner or later a source of irritation, its removal is desired, and may be readily effected by seizing it with the hooked forceps, whilst an assistant holds the eyelids asunder, and either transfixing it at its base with a knife, detaching it on the side next the cornea, and then completing its removal with the same knife, or with scissors, in the manner above recommended for pterygium, or at once snipping it off in a transverse direction close to its root, with a pair of sharp curved scissors.

Though the prominence of the tumour is thus removed an opaque spot remains at the place.

4th.—*Abnormal development, or hypertrophy of the conjunctiva corneæ.*

An extension of membrane, like sclerotic conjunctiva, over a part of the cornea, is sometimes met with.

5th.—*Fungous excrescence of the conjunctiva corneæ.*

The whole cornea may be covered with a fungous excrescence, tuberculated on the surface, and of a red or livid colour.

6th.—*Fungous thickening and enlargement of the conjunctiva.**

In a child about 12 years of age, I found the conjunctiva, especially that part of it forming the palpebral sinuses, thickened, enlarged, of a somewhat gelatiniform consistence, and of a dirty yellow or light brown colour.

In other cases, the conjunctiva, over the sclerotica especially, has been found of a deep livid red colour and elevated in irregular soft smooth masses, overlapping the cornea and protruding between the eyelids like chemosis.

Such affections by their pressure tend to the destruction of the eye.

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* Exophthalmia fungosa.

7th.—*Various kinds of tumours of the conjunctiva.*

Polypi and warts, pedunculated or sessile, may be met with growing from any part of the conjunctiva. They should be removed by excision with the curved scissors.

Small hard vesicular tumours, of the size of pins' heads, are sometimes presented by the sclerotic conjunctiva. If seized and crushed with a hooked forceps they will disappear. They may, however, be at once snipped off with the scissors.

8th.—*Hydatids in the cellular tissue under the sclerotic conjunctiva.*

Acephalocysts and cysticerci have been occasionally met with under the sclerotic conjunctiva. They give rise to a vesicular tumour about the size of a pea, in general unaccompanied by inflammation or any other inconvenience. On dividing the conjunctiva, the hydatid readily escapes.

A gentleman, between 50 and 60, consulted me about a small vesicular tumour under the conjunctiva, between the semilunar fold, and the inner margin of the cornea. On examination, I found it could be made to slide in the subconjunctival cellular tissue. With a fine hooked forceps, I raised the conjunctiva in a fold and snipped it across with scissors, whereupon the vesicle slipped out and was received upon the edge of the lower eyelid. It was whitish, of the shape of an egg, and about a quarter of an inch in the long diameter. Though like a cysticercus, it proved on close examination to be an acephalocyst.

I saw the patient again a fortnight after, when I found the wound of the conjunctiva healed, but some slight fulness of the vessels and increased meibomian discharge, for which I prescribed an eyewater and salve.

The following case occurred to Mr. Canton, who kindly afforded me an opportunity of examining the cysticercus:—

Wm. S——, aged two years and seven months, a child of strumous diathesis, was brought as a patient to the Royal Westminster Ophthalmic Hospital. Seven months ago, its right eye was touched accidentally by the point of an umbrella, without giving rise, however, to any unpleasant symptom. A week or two afterwards, the father, on depressing the lower eyelid, observed, for the first time, a tumour attached to the eyeball, about the size of a small pea, and which the lid had entirely concealed from view. The tumour has, from that period to the present, been slowly and steadily on the increase, without producing any inconvenience.

The lower eyelid was now noticed to be slightly bulged forwards, near the inner canthus, and, upon depressing it, an oval tumour projected, the seat of which was the cellular tissue between the sclerotica and conjunctiva. Its size was that of the little finger nail, and it had so encroached upon the inferior palpebral sinus, that when the lids were even widely apart, it was completely concealed from view. Its consistence was that of soft jelly, and the colour, so far as it could be judged of through the rather vascular conjunctiva stretched over it, was yellowish. Vision was perfect, and the general appearance of the eye healthy, with the exception of the slight congestion just alluded to. The tumour did not appear to cause the child any annoyance, or to interfere with the movements of the eyeball or lids, but the father wishing to have it removed, I depressed the lower lid as far as possible, and with a curved pair of scissors cut away an elliptical piece of conjunctiva from the most prominent part of the swelling. A small quantity of thin, yellowish fluid, issued, together with a cysticercus—the two having composed the bulk of the little tumour. The edges of the wound were, at the end of two or three days, fully united.

The entozoon was perfect, about the size of a large garden pea.*

9th.—*Filaria medinensis or Guinea worm.*

Cases of the Guinea worm under the conjunctiva are on record.

SECTION II.—DISEASES OF THE SEMILUNAR FOLD AND LACRYMAL CARUNCLE.

The *lacrymal caruncle* consists of a mass of fibrous tissue similar to that of the tarsal cartilages, in which are imbedded follicles secreting a fluid of the same nature as that of the Meibomian glands, and pouring it out by twelve or fifteen excretory orifices on its surface, which is invested by the conjunctiva.* In the healthy state the lacrymal caruncle is of a yellowish-red colour, slightly tuberculated on the surface, which, in addition to the excretory orifices, is beset with very delicate scarcely visible hairs.

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* The Lancet, July 22, 1848.

The *semilunar fold of conjunctiva*, which encloses at its free edge a minute portion of fibrous tissue, similar in nature to the tarsal cartilages, is distinguished from the ocular portion of the conjunctiva by its reddish colour and greater thickness.

1st.—*Inflammation of the semilunar fold and lacrymal caruncle.*†

In the puro-mucous ophthalmiæ the semilunar fold and lacrymal caruncle are always very much affected.‡ But they are sometimes found the principal seat of inflammation; and this, especially as regards the lacrymal caruncle, occurs under two forms, viz., what may be called catarrhal, and what may be called phlegmonous.

2nd.—*Catarrhal inflammation of the semilunar fold and lacrymal caruncle.*

The conjunctiva forming the semilunar fold and investing the lacrymal caruncle is the principal seat of this inflammation, which is in its nature very analogous to catarrhal ophthalmia tarsi (p. 613, et seq.).

Symptoms.—The semilunar fold and lacrymal caruncle are very red and much swollen, as also the neighbouring parts more or less, and puriform mucus by-and-by collects in considerable quantity at the inner angle, the result of increased secretion from the conjunctiva and from the follicles of the caruncle.

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* Anciently the lacrymal caruncle was thought to be the secretory organ of the tears, and the lacrymal points the excretory orifices.

† Encanthis inflammatoria.

‡ The semilunar fold may be so much enlarged in purulent ophthalmia, as to resemble the membrana nictitans of quadrupeds, of which it is naturally the miniature analogue. In this state of enlargement, I have seen a surgeon cut a considerable piece of it away, under the erroneous impression that it was an excrescence from the conjunctiva.

There is a sensation as if a foreign body were lodged at the inner angle of the eye, with considerable lancinating pain, especially when the eyelids are moved.

In consequence of the displacement of the lacrymal papillæ and puncta, as well as their implication in the inflammation, the tears which collect in the lacus lacrymalis are not duly absorbed, and therefore drop down over the cheek.

Causes.—After cold, the irritation of inverted eyelashes and of foreign bodies appears to be the most common cause. The foreign bodies may be lodged behind the semilunar fold. A loose eyelash has sometimes been found to have accidentally entered one of the puncta by one end, and by its free end pointed against and irritating the semilunar fold and caruncle, to be the source of the irritation which has excited and which keeps up the inflammation.

Treatment.—All causes of irritation, if any still exist, being removed, the inflammation will sometimes subside under the use of fomentations with tepid water, rest to the eye, attention to diet, and a little laxative medicine. If not, the local applications recommended in catarrhal ophthalmia will be necessary (p. 162), with perhaps a leech or two to the skin at the inner angle.

3rd.—*Inflammation and abscess of the lacrymal caruncle.*

This is altogether analogous to abscess of the Meibomian glands. The symptoms are at first similar to those of catarrhal inflammation of the semilunar fold and lacrymal caruncle, but as suppuration takes place, the pain becomes throbbing, the redness darker, and the swelling greater, until it presents a yellow point, usually between the caruncle and semilunar fold. This point bursting or being opened with the lancet, the abscess is evacuated: whereupon the symptoms subside and the part heals. As a consequence of the suppuration, atrophy of the caruncle sometimes takes place.

Treatment.—When suppuration is threatened, warm fomentations are to be applied to the inner angle, and as soon as fluctuation is perceptible or a yellow point presents itself, the abscess is to be opened with a lancet.

4th.—*Chronic enlargement of the lacrymal caruncle and semilunar fold.**

Chronic enlargement of the lacrymal caruncle and semilunar fold sometimes occurs, and presents itself in the form of a red, soft tumour, tuberculated on the surface, bleeding readily on being touched, without pain, and of a size sometimes as great, it is alleged, as that of a nut, from which the semilunar fold in the form of wing-like processes extends behind the upper and lower eyelids.

Treatment.—As reduction of the tumour is sometimes eventually effected by simply pencilling it with the solution of the nitrate of silver or sulphate of copper, or with vinum opii, the surgeon must not proceed hurriedly to excise any part of the enlarged caruncle before giving these remedies a full and fair trial. If a portion of it should be removed, the caruncle, supposing it afterwards recovered its healthy condition, would be so much reduced in size, that it would no longer support the lacrymal papillæ and puncta in their proper adjustment to the lacus lacrymalis, the consequence of which would be stillicidium lacrymarum.

If, notwithstanding perseverance in the treatment indicated, the enlargement of the caruncle persists, its reduction must be attempted by means either of caustic or excision.

Cauterization.—The solid nitrate of silver is the caustic employed, and the manner of applying it is the same as is recommended in cases of enlarged tonsils, viz., to hold the point of the caustic pencil on the tumour until a small eschar has formed. This is done on different parts of the tumour, and repeated as the eschars fall away.

Excision.—A portion of the enlarged caruncle—one-half, or even two-thirds of it—may be excised, as is done in the case of enlarged tonsils. The eyelids being properly secured by an assistant, the excision is readily effected with the curved scissors, the surgeon first seizing the tumour by means of the hooked forceps.

5th.—*Polypous and fungous excrescences of the lacrymal caruncle and semilunar fold.*

Polypous and fungous excrescences occasionally grow from the semilunar fold, or lacrymal caruncle, or between the two, inflammation having, or having not, previously existed. They may be sessile, and no larger than a pin's head, or they may be pedunculated, and of considerable size.

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* Encanthis fungosa, encanthis benigna.

Small sessile excrescences I have seen cease to grow and eventually disappear without any interference. When this is not the case, and if they are large and cause inconvenience, they should be touched with the nitrate of silver in solution or substance; or if pedunculated and large, they are to be snipped off with the scissors, and their root touched with the caustic.

6th.—*Cancer of the lacrymal caruncle.*[*]

Some authors speak of cancerous disease primarily affecting the lacrymal caruncle, but this either does not occur at all, or is very rare. Implication of the lacrymal caruncle, however, in cancer commencing in neighbouring parts, sometimes occurs.

[*] Encanthis maligna.

CHAPTER IX.

DISEASES OF THE LACRYMAL ORGANS.

SECTION I.—DISEASES OF THE SECRETING LACRYMAL ORGANS.

1st.—*Disordered states of the lacrymal secretion.*

THE secretion of the lacrymal gland may be suppressed, or, on the contrary, it may be poured out in too great abundance. These disordered states of the lacrymal secretion, it is well known, are frequently the result of mental affections. Suppression of the secretion is more common in old age, excess of secretion in youth.

In all cases these states are to be viewed in the light rather of symptoms than of diseases in themselves. They may both of them present themselves indeed in different stages of one and the same disease.

2nd.—*Suppression of the lacrymal secretion.**

Dryness of the eye from suppression of the secretion of the lacrymal gland, has been distinguished from dryness of the eye depending on defective secretion of mucus by the conjunctiva; but it may be questioned whether a suppression of the secretion of the lacrymal gland, independently of any disturbance of the conjunctival secretion, is a cause of dryness of the eye, for in cases in which the lacrymal gland has been extirpated, the eye has continued to be sufficiently moistened by the conjunctival secretion, which in fact is the ordinary means of moistening the eye.

The dryness of the eye which sometimes attends amaurosis, appears to be owing to a disturbance in the secretory action as well of the conjunctiva as of the lacrymal gland.

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* Lacrymal Xeroma.

Obliteration of the excretory ducts of the lacrymal gland is spoken of as a cause of lacrymal xerophthalmia, but such a condition appears to be, as I have above expressed my belief, rather assumed than unequivocally established by any direct observation.

The fact appears to be, that, as above stated (pp. 261, et seq.), xerophthalmia is always conjunctival, depending on a cuticular state of the conjunctiva, and that the secretion of the lacrymal gland may or may not be suppressed.*

3rd.—*Epiphora, or watery eye.*

This is superabundant secretion of tears, and most commonly presents itself as a symptom of irritation of the conjunctiva. This irritation may be owing to inflammation, especially scrofulous inflammation of the membrane, or, as is well known, to the action of chemical or mechanical agents—cold winds, acrid vapours, or foreign particles in the oculo-palpebral space, inverted eyelashes, &c.

Epiphora, as above pointed out (p. 13), is to be distinguished from *stillicidium lacrymarum*, another form of watery eye; the latter arising not from superabundant secretion, but from a morbid state of the derivative lacrymal organs, whereby they are unable to draw off into the nose the fluid which is always collecting in the lacus lacrymalis at the inner corner of the eye. But as the morbid state of the derivative lacrymal organs is frequently accompanied by an irritable state of the conjunctiva, epiphora may exist at the same time with stillicidium lacrymarum.†

Treatment.—The treatment is of course the removal of the cause, whether inflammation, of whatever kind it may be, or chemical or mechanical irritants of the conjunctiva, &c.

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* Obliteration of some of the ducts of the lacrymal gland has been alleged to be the condition of another disease, viz., dacryops, or lacrymal tumour of the upper eyelid.

† Some authors employ stillicidium lacrymarum in the sense in which epiphora is above used.

4th.—*Inflammation of the lacrymal gland.*

Inflammation of the lacrymal gland is not of common occurrence; and although acute and chronic forms of it have been described, there are no very certain marks by which they may be distinguished, beyond pain and fulness in the situation of the lacrymal gland accompanying suppression of the lacrymal secretion in the acute form, but increased secretion in the chronic, with displacement of the eyeball downwards and inwards.

The obvious treatment in such cases is the application of leeches and fomentations to the part, and the usual general remedies.

Inflammation going on to suppuration sometimes occurs in the situation of the lacrymal gland, generally in consequence of blows. In such cases the abscess is probably in the cellular tissue in or around the gland, and may present all the severe symptoms and displacement of the eyeball attending orbital abscess, into which, indeed, it may merge. It may become complicated with disease of the bone. In the latter case, after the abscess has burst or been opened, there remains a fistula, which cannot heal until the diseased portion of bone has exfoliated; but besides that, the skin around becomes diseased, and is so drawn in or contracted by cicatrices at the fistulous opening, that ectropium or lagophthalmus is produced.

The bad results which may follow an abscess in, or in the situation of the lacrymal gland, should induce the surgeon to be particularly circumspect in the management of such a case. If it is found resolution cannot be effected, as soon as the accumulation of matter is distinctly recognised, an issue is to be given to it, by an incision through the skin parallel to the margin of the orbit. In dressing the part afterwards, great attention must be paid to prevent the skin from being drawn in and contracted in a bad cicatrice.

Should the bone be found diseased, of course no attempt need be made to promote cicatrization until exfoliation of the diseased portion, which is always a tedious process; but even then the neighbouring skin is generally in so diseased a state, that contraction and bad cicatrization, with consequent lagophthalmos and ectropium, can scarcely be prevented.

5th.—*Fistula of the lacrymal gland or true lacrymal fistula.*

A minute fistulous opening, situated on the upper eyelid, towards the outer canthus, and under the margin of the orbit in the situation of the lacrymal gland, and from which a clear fluid discharges, has been said by Beer and others occasionally to remain after injury or the bursting of an acute abscess in the lacrymal gland. In one such case Beer effected a cure, by thrusting into the fistula, which was about a quarter of an inch deep, a knitting needle made red hot.

6th.—*Extirpation of tumours in the neighbourhood of the lacrymal gland, or of the diseased gland itself.*

Tumours sometimes occur in the neighbourhood of the lacrymal gland without this being itself affected, but the appearance externally may be such as to lead to the supposition that it is the gland itself which is enlarged and diseased. This should always be kept in mind in proceeding to the extirpation of what may be considered a diseased gland, and the operation proceeded in with great circumspection.

After the exposure of the tumour by incision of the skin, careful examination should be made to determine whether or not the tumour be really the lacrymal gland diseased, or simply a growth developed close by it. A case has occurred in which the operator removed by mistake a healthy lacrymal gland along with a steatomatous tumour.

The disease of the lacrymal gland, for which its extirpation has been undertaken, is enlargement and induration; but whether of a really cancerous nature or not, there is a difference of opinion.

Before any enlargement is observed externally, the patient may have suffered from pain in the situation of the lacrymal gland and epiphora. When a tumour becomes perceptible it is hard and knotty. As it increases in size, it forces the eyeball downwards, inwards, and forwards; the consequence is at first double vision from the displacement of the axis of the eye, and subsequently dimness of sight and loss of vision, from the action of the pressure on the retina.

Under these circumstances, extirpation of the diseased gland is indicated, as discutient treatment has usually proved of no avail.

The operation is performed by making an incision through the skin over the tumour parallel to the edge of the orbit, and of a length sufficient fully to lay bare the anterior part of the tumour. This being done, the surgeon will discover on examination of the size and connections of the tumour, if he had not been able to determine before, whether this single incision will suffice, or whether it will be necessary to carry another from its middle, and perpendicular to it upwards, through the skin of the eyebrow. The exposed gland is now to be seized with a hook or hooked forceps, drawn forwards, and separated from its connections with the scalpel.

The tumour being removed, the cavity in which it was seated is to be carefully explored by means of the finger, to ascertain if none of the indurated mass still remains. When the bleeding has ceased, the wound is to be freed from adhering clots, and its edges brought together by suture. A compress and bandage will promote the return of the eyeball to its natural position, and by this the sides of the cavity left by the removal of the tumour will be in a great measure approximated.

It has been recommended in extirpating the eyeball, to extirpate the lacrymal gland also, whether diseased or not. In support of this recommendation, M. Velpeau mentions a case of extirpation of the eyeball, in which the surgeon was forced, six months after, to remove the lacrymal gland which he had left in the orbit, in consequence of the abundant lacrymation which was kept up.

After extirpation of the lacrymal gland, it has been found that the conjunctival surfaces continue to be moist as usual; this appears to depend on their own secretion, and is a proof that xerophthalmia cannot be owing to suppression of the lacrymal secretion alone, but to an accompanying suppression of the conjunctival secretion. Indeed, it has been above seen that the dryness of the eye in *cuticular conjunctiva* exists although there may be no suppression of the lacrymal secretion.

SECTION II.—DISEASES OF THE DERIVATIVE LACRYMAL PASSAGES.

Obstruction in some part of the course of these passages is generally an accompaniment of their diseases, and the most marked and troublesome symptom attending it is *stillicidium lacrymarum*, or, as it has been improperly called, *fistula lacrymalis*. It is a dropping of tears from the eye over the cheek, in consequence of the obstruction in the derivative passages preventing their being drawn off into the nose in the natural manner.

Dryness of the nostril of the affected side sometimes attends obstruction of the derivative lacrymal passages. This has been attributed to the non-arrival of the tears into the nose. But if, on the one hand, we take into consideration the quantity of fluid which is received from the eye by the nose, and the small extent of surface in the nose over which that fluid can be dispersed; and on the other the copious secretion of mucus of which the whole lining membrane of the nose is naturally the seat, it will be perceived that the presence or absence of the fluid from the eye can have little if any—I should rather say no, influence on the state of the lining mucous membrane of the nose, as regards dryness or moisture. Dryness of the nostril, it is to be observed, does not always accompany obstruction of the derivative lacrymal passages, and when it does occur, it appears to be owing to diminution or suppression of its own mucous secretion from concomitant inflammation in the part.

The smell, like that of dust, which is sometimes perceived, appears to be a subjective sensation, depending on dryness of the nostril.

In cases of obstruction of the nasal duct, when, by pressure over the lacrymal sac, the accumulated mucus and tears are evacuated through the puncta, the stillicidium is for some time after relieved. From this it is to be inferred that a syphon action by the nasal duct is not necessary for the absorption of the tears.

That pressure by the orbicularis palpebrarum muscle, in the act of winking, contributes to driving the contents of the lacrymal sac through the nasal duct into the nose, when that passage is free, may be inferred from the fact, that in cases in which the nasal duct is obstructed, we often see the tears and mucus accumulated in the sac regurgitate through the puncta in the act of winking.

The proper conditions for the tears to be drawn in by suction produced by a diastole of the lacrymal sac succeeding to its compression by the orbicularis, I do not think exist. I believe that there is not sufficient valvular apparatus for the purpose; while the puncta, on the other hand, do not stand sufficiently wide open.

It is quite true that the canalicules, sac, and nasal duct are always filled with fluid, and that, in fact, the fluid in the conjunctival space is always continuous with that of the nose. But the inference to be drawn from this in respect to the mode in which the tears are drawn off from the lacus lacrymalis, is, that the thinner tears are diffused into the thicker mucus of the sac, duct, and nose.

When the nasal duct is obstructed, reaccumulation of tears in the sac, after it has been emptied through the puncta by pressure, must take place by diffusion.

1st.—*Inflammatory swelling, abscess, or sinuous ulcer in the region over the lacrymal sac.*

Inflammation of the skin and subjacent cellular tissue in the region over the lacrymal sac sometimes occurs.

Symptoms.—There is at first diffused erysipelatous-like redness and swelling, with pain in the region over the lacrymal sac. The eyelids, conjunctiva, and lacrymal passages are apt to be more or less affected sympathetically, the Meibomian and conjunctival secretions are therefore poured out in increased quantity, whilst the tears, not duly drawn off into the nose, drop over the cheek.

The inflammation in general runs on to the formation of diffuse abscess, *Anchilops* of the older surgeons, the redness at the same time becoming darker, the surrounding œdema greater, and the pain pulsating and severe.

Left to itself, the abscess usually bursts externally, and gives out matter mixed with blood and sloughy cellular tissue, leaving a sinuous ulcer (called by the older surgeons *Ægilops*).

At the same time that a sinuous ulcer is established, the ulceration may extend inwards, perforating the wall of the lacrymal sac, thus giving origin to what is called spurious fistula of the lacrymal sac.

The inflammation under consideration is of the same nature as scrofulous abscess.

The following case will illustrate the progress and treatment of a severe form of this disease:—

A girl, æt. 7, has for some time past suffered from inflammation and repeated small abscesses in the region over the lacrymal sac. When she came under my observation I found a small abscess, and the skin livid around.

The matter was evacuated by an incision with a lancet.

After this the affected skin was pencilled with solid caustic at intervals of two days.

A week after, the external swelling was much diminished in size. On pressure over the sac, some tears, mixed with flakes of mucus, flowed out by the puncta.

The pencilling with the caustic repeated, and iodide of potassium, with decoction of sarsa, ordered.

This treatment was continued for about three weeks. Improvement going on slowly, and sometimes interrupted by increased discharge of matter.

After this, the girl was put on a course of cod-liver oil, and had blisters applied occasionally behind the ears. The weaker mercurial ointment was rubbed in over the affected part.

Under this treatment, continued for two or three months, the redness and swelling of the skin at last subsided, and the ulceration healed to a small fistulous opening, through which tears escaped.

Through this opening I subsequently passed a fine probe into the lacrymal sac and nasal duct. This probe I exchanged for a thicker and a thicker at intervals of two days, until a small style could be introduced, which was then left.

2nd.—*Catarrhal inflammation of the derivative lacrymal passages.*

In nasal catarrh, the inflammation and tumefaction which affects the pituitary membrane may implicate the mucous membrane of the derivative lacrymal passages also, so that the transit of the tears to the nose is somewhat obstructed.

A consequence of this is the swimming of the eye in tears, which so often accompanies nasal catarrh. This swimming of the eye is also in part due to an increased discharge of tears from the lacrymal gland, occasioned by the catarrhal state in which the conjunctiva is, at the same time, more or less in such cases.

As the cold in the head subsides, the free passage of the tears is restored. But it may happen that a repetition of such attacks, especially in scrofulous constitutions, shall leave the passages in a chronic blennorrhœal state.

3rd.—*Acute inflammation of the derivative lacrymal passages.*[*]

The derivative lacrymal passages are sometimes, though not very often, the seat of idiopathic acute inflammation. The disease is at first characterised by a hard circumscribed swelling, of the size and shape of a horse-bean,[†] in the situation of the lacrymal sac, with great œdema of the eyelids.

The swelling over the sac is red and extremely painful to the slightest touch. The conjunctiva, semilunar fold, caruncle, and Meibomian glands are sympathetically affected. There is *stillicidium lacrymarum.* The pain radiates in all directions, and is accompanied by throbbing. To these local symptoms may be superadded inflammatory fever, with sometimes delirium at night.

The inflammation sometimes terminates in resolution, more frequently in abscess. In the latter case, along with increase of the throbbing pain, the swelling enlarges, and becomes darker red, and at last soft, and fluctuating. The œdema of the eyelids and neighbouring parts is at the same time much increased.

The canaliculi and nasal duct having been closed by tumefaction of their lining membrane, in an early stage of the attack, the matter accumulates in the sac, which thus appears to be the focus of the disease.

Left to itself, the abscess points and bursts, usually below, though sometimes above, the tendon of the orbicularis palpebrarum. From the closure of the canalicules and nasal duct, there is no escape for the matter through them.

The evacuation of the abscess is followed by great relief; and in favourable cases, the inflammation subsides; the canalicules again become pervious, and allow the passage of the tears into the sac, so that what is now discharged through the fistulous opening is puriform mucus mixed with tears. By-and-by the fistulous opening into the sac contracts, and closes, while the lining membrane of the latter and of the nasal duct returns to its natural state, and a free passage for the tears into the nose is re-established.

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[*] Acute dacryocystitis, or acute inflammation of the lacrymal sac.

[†] The bean shape of the swelling is owing to the lacrymal sac being somewhat bound down about the middle by the tendon of the orbicularis palpebrarum, whilst above and below it has freer scope to swell.

Acute inflammation of the derivative lacrymal passages may not terminate so favourably. The lining membrane of the sac and nasal duct may remain thickened, and in a blennorrhœal state, and the fistulous opening, perhaps, continues, constituting what is called a *fistula of the lacrymal sac.*

Treatment.—In the early stage of the disease, leeches should be applied to the temples or around the inner angle of the eye, and also to the entrance of the corresponding nostril. In the robust adult, it may be advisable, if the pain be very severe, to abstract blood by venesection. Fomentations are to be applied to the part, rest and abstinence enjoined, and the bowels and skin acted on by laxatives and diaphoretics.

If by these means suppuration should not be averted, the sac is to be opened as soon as it becomes soft and fluctuating, and issue given to its contents. The opening of the sac is effected by thrusting the lancet, held with its flat surfaces parallel to the margin of the orbit perpendicularly into the part of the distended sac below the tendon of the orbicularis palpebrarum, and, in withdrawing the instrument, enlarging the opening inwards and a little upwards.

After the incision of the sac, the fomentations are to be continued. There should be no sounding with probes: nothing done directly to the parts for the next day or two after the opening of the sac.

When everything has become quiet, and before permitting the opening into the sac to close, the surgeon must satisfy himself of the perviousness of the canaliculi and nasal duct. The absence of stillicidium lacrymarum, and the presence of tears in the sac, will show that the puncta and canalicules are doing their duty; and the entrance into the nose of water, injected into the sac, will show that there is perviousness in that quarter.

If any doubt should remain as to the perfect freedom of the nasal duct, an exploration is to be made by sounding it with a probe.

4th.—*Chronic inflammation of the derivative lacrymal passages.*[*]

Chronic inflammation of the derivative lacrymal passages is usually accompanied by a chronic inflammation of the palpebral conjunctiva, and of the ocular conjunctiva at the inner corner of the eye, so that at first sight the case might be taken for one of catarrhal ophthalmia. But on closer examination, a fulness and perhaps redness, will be perceived in the situation of the sac, and on making pressure at the place, tears, mixed with streaks of puriform mucus, will escape by the puncta, and perhaps also by the nose.

The mucous membrane of the passage is thickened, and secretes a puriform mucus. This thickening of the mucous membrane tells most on the perviousness of the nasal duct; for being surrounded by unyielding bony walls, the tumefaction tends inwards, so that the canal becomes so obstructed that the tears can no longer pass. As, however, the puncta and canaliculi generally continue to perform their office of transmitting the tears, the latter accumulate in, and distend the sac, from whence, by pressure on it, they are regurgitated through the puncta, mixed with flakes of the puriform secretion of the diseased mucous membrane, as already mentioned. The regurgitation is sometimes occasioned by the mere pressure exerted by the orbicularis muscle on the distended sac, during the movements of the eyelids.

After the sac has been emptied through the puncta, the eye remains free from stillicidium until the sac again becomes filled, and can no longer receive any more tears.

Chronic inflammation of the derivative lacrymal passages may come on quite imperceptibly, the watering of the eye being the symptom which first attracts the patient's attention. It may succeed to an attack of acute inflammation of the passages, or to an inflammation of the skin and cellular tissue over the sac, or, as is frequently the case, it is a sequela of one of the exanthemata (pp. 251, et seq.).

In a case of ophthalmia neonatorum in which abscess of the sac formed, and was opened, blennorrhœa, with fistula of the sac, remained.

Besides the affection of the conjunctiva already mentioned, the disease of the lacrymal passages may be complicated with a similar state of the mucous membrane o the nose, of the Eustachian tube and cavity of the tympanum, with consequent deafness.

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[*] Chronic dacryocystitis.—Blennorrhœa of the lacrymal sac.

In warm dry weather all the symptoms are much relieved or disappear altogether; but in cold and wet weather they become aggravated.

This disease is usually connected with a faulty state of health. It most frequently occurs in scrofulous constitutions. Sometimes it is of syphilitic origin.

In cases of chronic inflammation of the derivative lacrymal passages, an acute attack, with abscess, may supervene from exposure to cold, &c. If not timely opened, great pain is suffered, while the distension of the sac goes on increasing: at length it bursts, and the severity of the symptoms is relieved.

Should the opening in the sac, whether made by the knife, or produced by the spontaneous bursting of the abscess, again close without the passages being first restored to a healthy state, the same process of acute inflammation and abscess may take place over again from any new exposure.

In some cases, repeated attacks of this kind will be found connected with caries of the surrounding bones, especially the lacrymal and inferior spongy; the disease of the bones being of a scrofulous or syphilitic nature.

General treatment.—As the digestive organs are very commonly disordered, particular attention must be directed to them, if this has not been already done irrespective of the local disease. A mild nourishing diet, a course of some gentle mercurial, such as hydrargyrum cum creta and laxatives, followed by disulphate of quinine or other tonic, will be found beneficial in many cases. Iodide of potassium is a remedy under the use of which alone cures have been effected. As the skin is often in an unhealthy state, attention should be directed to it. Daily friction of it should always be practised.

Local treatment.—Counter-irritation behind the ears is to be used, premised, if need be, by the application of leeches to the temples or over the sac, and to the entrance of the nostrils. Besides these, the eye should be bathed three times a day with some eyewater, such as that of hydr. bichlorid. (p. 81), and weak red precipitate ointment (p. 85) applied to the edges of the eyelids at bedtime. These remedies act by subduing the attendant conjunctivitis, and if care be taken to keep the lacus lacrymalis filled for some minutes with the eyewater each time it is used, the sac having been previously emptied by pressure, some of it will be absorbed by the puncta and conveyed along the canaliculi into the sac, and will be thus brought into direct contact with the mucous membrane, which is the seat of the disease, and will act on it as beneficially as on the conjunctiva. It has been fancied that the direct injection of a lotion by means of Anel's syringe, with a very fine nozzle, through the puncta and canaliculi, into the lacrymal sac, would operate more effectually than a lotion applied in the manner we usually direct it, but experience has not given the stamp of value to the practice. Friction with mercurial ointment over the sac and side of the nose is useful.

If the above treatment prove unavailing in removing the chronic inflammation and restoring the free passage of the tears to the nose, the propriety of operative interference will come to be considered.

5th.—*Phlegmonoid erysipelas supervening in the course of inflammation of the lacrymal passages.*

The following was a case of the kind:—

The patient, a woman of about 38, rather delicate-looking, had been nursing her baby for the last twelve months. She had previously long laboured under chronic blennorrhœa of the lachrymal sac on the right side, and had been in the habit of pressing out by the puncta the puro-mucus and tears as they accumulated in the sac.

Having caught cold, acute inflammation of the lacrymal sac supervened on the chronic inflammation, and she was compelled, by the severity of the symptoms, to apply for relief at the hospital.

On examination, I found the lacrymal sac hard, and very painful to the touch, but not greatly distended with matter. There was, however, erysipelatous inflammation of the skin over the sac, with great swelling and œdema of the eyelids and cheek.

The patient was ordered three grains of blue pill, and two of extract of hyoscyamus, and told to apply warm fomentations to the part.

When we next saw the patient, two days after, we learned that she had been suffering from very great pain and depression, and on examination found a diffuse abscess in the region over the sac, extending into the lower eyelid and cheek. On the left side the eyelids had become œdematous. I made a free incision with a lancet through the skin into the subjacent cellular tissue over the sac, and evacuated some thickish matter. Besides this incision, I made two or three punctures through the skin of the lower eyelid and cheek, from which a white milky matter and blood escaped. After this, the application of warm cataplasms was ordered, and a powder of rhubarb, soda, et hydrarg. c. creta twice a day.

When the patient was next seen, three days after, she was free from pain, the swelling of the eyelids and cheek had subsided, and there remained merely some redness and swelling over the sac where the incision had been made through the skin.

It will be observed that in this case the lacrymal sac was the part first affected, but that in the subsequent course of the disease it was the skin and subjacent cellular tissue in which the development of the inflammation took place.

Had the case been left to itself, the abscess would have burst externally, and given out matter mixed with blood and sloughy cellular tissue.

At the commencement of the acute attack of inflammation of the lacrymal sac, in consequence of the supervening tumefaction of the lining membrane of the lacrymal canaliculi, matter no longer admitted of being pressed from the sac through the puncta. There was no abscess of the sac.

Matters eventually resumed their former state, that is, the case returned to what it was before, viz., one of chronic blennorrhœa of the lacrymal sac.

Sometimes, it may be observed that in such cases ulceration proceeds inwards, and perforates the wall of the lacrymal sac, giving origin to what has been called spurious fistula of the lacrymal sac (p. 697).

6th.—*Atony or relaxation of the lacrymal sac.*[*]

In some case of chronic inflammation of the derivative lacrymal passages, the sac becomes much dilated and relaxed, its wall being at the same time thickened, so that the tears and mucus accumulate in it in very considerable quantity, even although the nasal duct be not obstructed. The swelling at the inner corner of the eye, produced by this state of the sac, is soft and without pain; and the skin is in general not at all discoloured.

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[*] Hernia of the lacrymal sac.

By pressure on the sac, the accumulated tears and mucus may be expelled both through the puncta into the eye, and through the nasal duct into the nose. By holding the face down while the pressure is made on the sac, a considerable quantity of fluid will sometimes drop from the nose.

Treatment.—The first object in the treatment is to improve the state of the mucous membrane of the derivative lacrymal passages, and this is to be attempted by the use of astringent lotions dropped into the lacus lacrymalis to be absorbed or injected at once into the passages through the puncta by means of Anel's syringe.

Frequent and continued pressure over the sac is of great use. The patient, if properly instructed, may effect this himself with his finger, in a manner superior to what can be done by any of the *compressoria* which have been invented for the purpose.

Should the state of the mucous membrane not be improved by the treatment, and should, on the contrary, the nasal duct come to give passage to the tears less readily, then it will be proper to consider the propriety of operating directly on the nasal duct, in the manner to be treated of below.

7th.—*Mucocele of the lacrymal sac.*[*]

Mucocele is a swelling of variable size, sometimes livid, generally elastic, in the situation of the lacrymal sac, not at first, though it may come at last to be very painful to the touch.

When pressure is applied, there is no escape of any matter, either by the puncta or by the nasal duct.

This disease appears to depend on the slow accumulation and inspissation of the mucous secretion of the sac itself.

A mucocele may exist for a long time—for years—without discoloration of the skin, without pain, elastic, and with an indistinct fluctuation, but may become enlarged, hard, livid, and painful, from an attack of inflammation in the part.

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[*] Dropsy of the lacrymal sac.

The contents of the distended sac are fluid in the earlier stage, but of a gluey consistence from inspissation in one more advanced.

Treatment.—The treatment consists in first laying open the tumour with a knife, evacuating the contents of the sac, and then injecting tepid water to clear it out completely. If the contents are consistent and gluey, it will be necessary to scoop out the mass before injecting the water.

The sac having been cleared out, the next business is to examine the state of the canaliculi and nasal duct, and to treat them in the manner to be described below.

8th.—*Mucocele of the lacrymal canalicules.*

The lacrymal canalicules are sometimes found distended into a round tumour about midway between the punctum and the sac by a concretion of inspissated mucus. The tumour projects equally towards the skin and the conjunctiva, and is of a livid red colour.

A gentleman, six months before I saw him, began to be troubled with stillicidium lacrymarum of one eye. On examination, I found the edges of the eyelids and the palpebral conjunctiva inflamed with increased Meibomian secretion. I also found a swelling in the region of the lower canalicule with a red fungous condition of the mucous membrane at its mouth.

Having slit up the lower canalicule on a probe, a concretion of a putty-like consistence was turned out. The lining membrane of the canalicule was very red and much thickened.

From the upper canalicule, the punctum of which presented a similar red fungous condition of its mucous membrane, there oozed out a tenacious mucus. This canalicule was also slit up on a probe.

9th.—*Exostosis of the inner and posterior wall of the lacrymal fossa.—Gummatous enlargement of the tendo oculi.*

These give rise to a projection in the region of the lacrymal sac, resembling the swelling of a mucocele.

10th.—*Fistula of the lacrymal sac.*

After the evacuation of an abscess of the lacrymal sac by bursting or incision, if the lining membrane still continue unhealthy, and the nasal duct obstructed, the opening into the sac, though it contracts, may not entirely close, but remain in a fistulous state with callous edges.

The fistulous opening in the skin may correspond with that of the sac, or the communication between the two openings may be through a sinus. There may be more than one opening in the skin with a corresponding number of sinuses.

Sinuses of this description are to be distinguished from sinuses in the same situation not communicating with the sac (p. 697). Sinuses thus arising we have seen, however, sometimes penetrate inwards by ulceration of the wall of the sac.

True fistula of the lacrymal sac is to be closed only after restoration of the passages to a healthy state, if that is possible; if not, the palliative treatment described below must be had recourse to.

11th.—*Exploration of the puncta and canaliculi.*

The instrument employed is a slender gold probe, commonly called Anel's probe. The first steps in the operation are the same as in that of the introduction of the blunt-pointed pin into the puncta described below.

Lower canalicule.—Having entered the probe, held lightly between the thumb and forefinger, into the punctum, and pushed it downwards to the dilated bottom of the vertical part of the canalicule, that is, to the depth of about one-tenth of an inch, withdraw it a little and change the vertical direction of the probe downwards for a horizontal one inwards, or rather for one deviating from the horizontal inwards, so as to be slightly oblique from below upwards, which is the direction of the second part of the canalicule. At the same time that the direction of the probe is thus altered, the inner part of the lower eyelid is to be stretched, by the finger holding it, towards the temple, and pressed slightly more downwards, in order as much as possible to undo the curvature of the canalicule.

Upper canalicule.—Having pushed the probe upwards to the dilated bottom of the vertical portion of the canalicule, and then withdrawn it a little as above directed for the lower canalicule, the change of the vertical direction of the probe upwards is to be made for one deviating so far only from the horizontal inwards, as to be slightly oblique from above downwards. At the same time that this is being done, the inner part of the upper eyelid is to be stretched towards the temple, and somewhat more upwards, with the same view as that for which the analogous proceeding in the case of operation on the lower canalicule is directed.

The manœuvre just described being performed, whether in the case of the lower or upper canalicule,—and it is the work of a second or two only,—the probe is pushed on towards the lacrymal sac.

If there be actual obliteration of the canalicule in some part of its course, the probe will be arrested in its progress towards the lacrymal sac. . But it must not be too hastily inferred that obliteration exists, when the probe is so arrested. Often, by delicate manipulation and rotation of the instrument, it is at last made to pass on into the sac, showing that, though there is stricture or obstruction from tumefaction of the lining membrane, there is no obliteration.

12th.—*Atony or relaxation of the papillæ with a dilated state of the puncta.*

The puncta may be found dilated, with the papillæ relaxed, and not properly directed towards the lacus lacrymalis. This state is usually found connected with some chronic inflammation of the conjunctiva of the blennorrhœal kind. There may also be present defective action of the tensor tarsi muscle and of the orbicularis.

Treatment.—The application to the parts of the drops of the nitrate of silver, or of the lapis divinus with vinum opii (p. 83). If this fails, the canalicule is to be slit up.

13th.—*Shrunk papillæ and contracted state of the puncta.*

When the lacrymal puncta are contracted, the first object should be to endeavour to dilate them, and for this purpose a common pin, of a proper thickness, rendered blunt and smooth at the point by rubbing on a whetstone, is a very good instrument.

Lower punctum.—The patient being seated before a window, the surgeon holds the edge of the lower eyelid, towards the inner angle, a little depressed and everted with one hand, so as to bring into view the punctum, while with the other he introduces the point of the pin, with a rotatory movement between his thumb and forefinger, into the lower punctum downwards in the direction of the vertical portion of the corresponding canalicule into which he passes it a little way.

Upper punctum.—The operation on the upper punctum is the counterpart of this, but not quite so simple. The upper eyelid towards the inner angle being held raised and everted, so as to expose the punctum, the blunt-pointed pin is introduced into it, and pushed with a rotatory movement upwards in the direction of the axis of the vertical portion of the corresponding canalicule.

The operation is to be repeated with thicker and thicker pins if necessary, until the puncta are sufficiently dilated to admit easily a moderately-sized Anelian probe for the exploration of the canaliculi.

14th.—*Everted and shrunk papillæ with a contracted state of the puncta.*

In this case, the canalicule is to be slit up from the punctum towards the caruncle on the conjunctival side so that an orifice may be presented towards the lacus lacrymalis for the absorption of the tears therein collected. To effect this, a probe is introduced to serve as a conductor on which to slide the fine sharp-pointed knife used for the purpose. The canalicule having been slit up, the probe is to be raised on its point out of the canal, in order to make sure that the slitting up has been completely effected. To prevent reunion of the cut edges, the probe is to be passed and thus raised up daily for a few days.

In a case of everted and shrunk papilla of the lower lid, in which the punctum could not be found, Mr. Streatfeild having slit up the canalicule of the upper eyelid, introduced a fine probe bent at the point into a curve through it into the sac, and thence through the lower canalicule to the contracted punctum. Through this the point of the probe was successfully forced from within outwards. (Opth. Hosp. Rep. vol. iii. p. 4).

15th.—*Obstruction of the lacrymal canalicules.*

Obstruction of the canalicules from inflammatory tumefaction may exist independently of a similar affection of the derivative lacrymal passages in general, though most frequently it is a part merely of a general affection of those passages. But, on the other hand, it is to be remarked that *the canalicules may be, and very frequently are, little or not at all affected when the lacrymal sac and nasal duct are much affected.*

This is shown by what is ordinarily the case in chronic inflammation of the passages, viz., that the tears are taken up and conveyed into the sac, and not having a passage to the nose on account of the obstruction of the nasal duct, accumulate there, and, intermixed with streaks of puriform mucus, may be readily regurgitated through the puncta, by pressing on the sac (p. 701).

Although, in obstruction of the canalicules from tumefaction of the mucous membrane, a probe might be made to pass, the swollen membrane would, when the probe was withdrawn, again fill up the canal. In such a case, therefore, the introduction of a probe would be useless, if not positively hurtful. The obstruction is to be overcome only by removing the inflammatory and thickened state of the membrane on which it depends.

Treatment.—If by the repeated pressing out of the contents of the sac and the application thereafter of the vinum opii drops or the drops of lapis divinus with vinum opii (p. 83) to the conjunctiva, which is at the same time affected, improvement does not take place, the only resource is to slit up the puncta and canalicules, as recommended by Mr. Bowman.

Having slit up one or both puncta, as may seem desirable, the canalicules are to be probed to ascertain whether they open freely into the sac.

In exploring the canalicule, No. 6 or the full-sized probe is to be tried first, but if it will not pass, No. 4 or No. 2 may be tried; and if these fail, it is better to postpone further proceedings till a few days have elapsed, and the slit in the canal is permanently established.

Stricture in the canals is not of frequent occurrence, and when it is met with, it is commonly at the entrance into the sac.

16th.—*Imperforate punctum.—Obliteration of the lacrymal canalicules.*

Imperforate punctum is sometimes met with as a congenital malformation.

Obliteration of a canalicule is generally the result of a wound or burn, and of which the scar may be still observable. If one canalicule only be obliterated, the tears may continue to pass without interruption by the other; hence, no surgical interference will be required. Obliteration of both canalicules gives rise to stillicidium lacrymarum.

Treatment.—Between the place of obliteration and the sac, the canalicule is to be opened from within, by a cross snip with a pair of straight scissors. The probe point of a pair of Maunoir's scissors being now entered into the gaping orifice, the canalicule is to be slit up towards the caruncle.

Jüngken * appears to have succeeded by such an operation as this, in curing a young man in whom a burn of the inner corner of the eye with a hot iron, by which he was struck, had occasioned obliteration of the canaliculi, with adhesions between the internal commissure of the eyelids, the lacrymal caruncle, and the semilunar fold.

17th.—*Exploration of the nasal duct, to determine whether it is obstructed or obliterated.*

In obstruction to the transmission of the tears from the eye into the nose, attending any of the affections of the derivative lacrymal passages above described, if we have satisfied ourselves that the puncta and canaliculi are not in fault, we naturally direct our attention to the nasal duct.

The nasal duct is much more frequently obstructed or wholly impervious than any other part of the derivative lacrymal passages. This, as above mentioned (p. 701), appears to depend, in a great measure, on the circumstance, that when its lining mucous membrane is tumefied or thickened, the space necessarily required for the increase of bulk is taken at the expense of the calibre of the duct itself, no distension outwards being permitted by its bony walls. Lymph being thrown out in this state, either within or without, permanent obliteration results.

Exploration of the nasal duct may be made in four different ways, viz.:—1. By an Anelian probe introduced through one of the puncta and canalicules into the sac, and thence down into the nasal duct. 2. The punctum and canalicule having been first slit up, by the introduction of a probe into the sac, and thence down into the nasal duct. 3. By the introduction of a probe through an opening into the sac, either already existing, or made for the purpose, below the tendon of the orbicularis palpebrarum. 4. By the introduction of a probe, properly curved for the purpose, from the nose.

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* Motherly, Diss. de atresia punctorum lacrymalium. Berolini, 1834.

Exploration of the nasal duct by an Anelian probe introduced through the upper or lower punctum and canalicule into the sac, and thence down the nasal duct.—Having, in the manner above described (p. 707), passed the probe through the upper or lower punctum along the canalicule as far as the sac, it is to be raised to a direction deviating from the vertical only by the point of the instrument being inclined backwards and slightly outwards, which is the direction of the nasal duct. By now pushing the probe down with a rotatory movement between the fingers, it will, if the duct be not closed or very much obstructed, come to strike on the floor of the nostril.

In regard to the direction just given to incline the point of the probe backwards and slightly outwards, it is to be observed, that the backward inclination of the point will generally, without any care on the part of the surgeon, be determined by the prominence of the eyebrow.

Mr. Bowman's method of exploring the nasal duct through a slit-up canalicule.—When the probe (No. 6) is thus introduced, it enters the sac behind the tendo-oculi. In order to find the orifice of the nasal duct, the larger probes (No. 5 and 6, which are the only ones used for this purpose) are slightly curved at each end in two different directions within the terminal inch or inch and a half, while the central part (or that held by the finger and thumb) is straight, and they are cylindrical in their whole length. The effect of this is that when the probe is inserted into the sac, and brought into a vertical position, a slight rotation of it on its long axis makes the lower point, which is in search of the orifice of the duct, describe a small circle; and by slightly varying the inclination of the probe and making gentle pressure at the same time with slight rotation, the point never fails to enter the duct. The right and left probes have opposite curves, to suit the inclination of the duct.

The probe is known to have entered the nostril by the depth to which it has penetrated, compared with the external position of the nostril, and also by its coming in contact with the floor of the nose. It is allowed to remain there for a few minutes, or is immediately withdrawn, according to circumstances.

Petit's method of exploring the nasal duct by the introduction of a probe through an external opening into the sac.—An opening into the lacrymal sac is made by incision of its anterior and outer wall, below the tendon of the orbicularis palpebrarum.

Instrument.—Perhaps the best instrument for the purpose is a small scalpel, with its back bevelled on either side, and running into a sharp edge at the point for the extent of about one-fifth of an inch. (Fig. 166.)

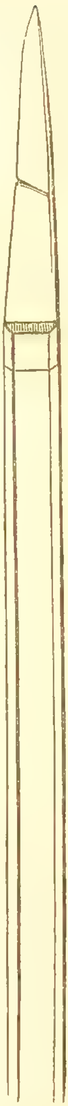

FIG. 166.

Incision of the sac.—Preparatory to the operation, the sac is to be allowed to become distended with fluid. The patient being seated opposite a window, the assistant, who stands behind holding the head, is to press the skin at the outer angle of the eye towards the temple, in order to stretch the skin over the sac, and thus to bring prominently into view the tendon of the orbicularis palpebrarum to serve as a guide (Fig. 167).

The surgeon, having touched and felt the part over the sac with his finger, takes the knife between his thumb and fore and middle finger, and proceeds to the penetration of the sac. The point of the knife is directed perpendicularly to the surface of the skin, *i.e.*, backwards and inwards, over the wall of the sac below the tendon of the orbicularis, its edge being directed outwards and somewhat downwards. The knife in this position having been made to penetrate the sac, which is known by the escape of fluid and cessation of resistance, its handle is to be raised and then the point pushed down a little way within the sac in the direction of the nasal duct. By the increasing breadth of the knife, a sufficiently large opening is made obliquely across the sac, parallel to the margin of the orbit, but in withdrawing the knife, the external incision may be enlarged a little outwards and downwards.

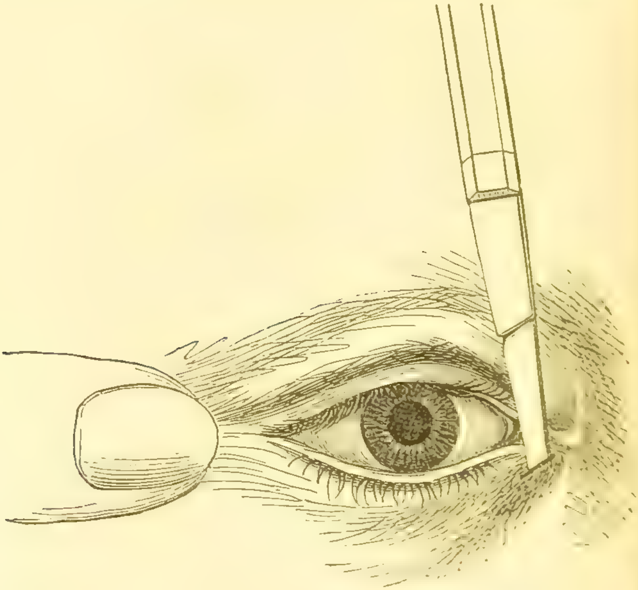

FIG. 167.

Introduction of the probe.—Direct the point of the probe, a whalebone one is the best, held nearly horizontally backwards and inwards through the opening in the sac until it strikes upon its opposite wall. Then withdrawing the probe slightly, direct its point down to the nasal duct, remembering that the direction of the latter is downwards, backwards, and outwards, and also slightly curved, the convexity being forwards. If the probe does not readily pass, it should not be forced down, but by moving about the point and rotating the instrument between the fingers and thumb, at the same time that pressure downwards is gently made, it will probably at last pass. If not, a tent is to be left in the opening into the sac, and the trial repeated next day. A whalebone probe is to be employed in the first instance, a silver one in the second.

Procedure when a fistulous opening already exists in the sac.—If a fistulous opening leading directly into the sac already exists, and if of sufficient size, the probe may be at once introduced through it into the nasal duct. Or if very small, it may be dilated by a succession of thicker probes.

If the opening in the skin does not correspond with that in the sac, a small director should be introduced through the former into the sinus. This being laid open to its bottom, the director is introduced into the opening in the sac, for the purpose of enlarging it by incision, as just directed.

Exploration of the nasal duct by the introduction of a probe from the nose.—Gensoul's sound, the instrument for the performance of the operation, is a probe bent, but not abruptly, at nearly a right angle, at the distance of about nine-tenths of an inch from the point. Close to this bend there is in the handle part of the probe a slight lateral one, to the right or left according to the nostril operated on, in order that the instrument may be accommodated to the projection of the nasal process of the superior maxillary bone.

It is to be remembered that the lower orifice of the nasal duct is in the anterior and upper part of the lowest meatus, at the lateral wall of the nasal cavity, and about one inch from the entrance of the nostril; that it is overhung by the lower spongy bone, and that it is of the form of an oblique fissure looking downwards and inwards.

The instrument is introduced into the nostril with its point and first concavity directed downwards and outwards. In this position the point is run along the floor of the nostril as far as the first bend. It is then to be elevated and grazed along the outer wall of the nostril towards the orifice of the duct; in executing this manœuvre, the handle of the instrument is with great delicacy to be carried from its original direction, outwards and somewhat downwards, to a horizontal direction, forwards, and this by slightly rotating the handle of the instrument between the fingers, and executing a curved sweep from below upwards. If there is no obstruction, the instrument is thus made to slip into the duct, and its end may be felt by applying the finger over the sac.

Appreciation of the four different ways above described of exploring the nasal duct.—All that can be ascertained by means of Anel's probes introduced through the puncta, canalicules, and sac into the nasal duct, is that this canal is or is not permeable to a probe necessarily very much smaller than its own diameter. But in consequence of the winding form of the canal along which the small probe is passed, there cannot be, except in very practised hands, much certainty whether an impediment which the probe may encounter be owing really to an obstruction in the nasal duct, or merely to the circumstance, that the small point of the probe has been caught in a fold of the lining membrane. Again, though the probe pass, there may, nevertheless, be obstruction sufficient effectually to prevent the passage of the tears into the nose. For these reasons, and for the violence done to the punctum and canalicule, this mode of exploration is not to be recommended.

As little is the operation to be recommended as a means of removing the obstruction. Such a small probe must be totally inefficient as a means of dilatation, or as a means of removing any obstruction that would continue to oppose the passage of the tears. And the few cases in which it is alleged benefit was obtained from the practice, were of a slight nature, and most likely would have been benefited without recourse to any such measure.

In regard to the exploration of the nasal duct by the introduction of a probe from the nose, it is to be observed that the lower orifice of the duct is not always readily hit upon by the point of the probe. It is, therefore, in most hands, an uncertain mode of exploration, and not well adapted as a means of removing obstruction of such a nature as that which affects the nasal duct. Besides, the introduction of the instrument is rather painful.

Excluding these two plans, therefore, there remain Mr. Bowman's method and Petit's method to choose between.

When the puncta and canalicules are healthy, as they are in a majority of cases, I would recommend Petit's method as that by which, whilst they are preserved untouched, the exploration of the nasal duct, as well as the application of means calculated to remove or palliate obstruction of it, can be most effectually made. The conjunctiva by this method, moreover, is not interfered with, and the eye, therefore, preserved free from irritation.

When the puncta and canalicules are affected and require to be slit up at any rate, Mr. Bowman's method ought to be had recourse to.

When, in the exploration of the nasal duct above described, the whalebone probe can be pushed down into the nose without any marked opposition, the surgeon merely feeling as if the probe were closely grasped by the walls of the passage, it may be inferred that the obstruction to the passage of the tears is owing merely to a general tumefaction or a somewhat fungous state of the lining membrane.

When considerable manipulation and rotation require to be made before the probe passes, or when it is only after repeated attempts on successive days that the probe is made to pass at all, thickening of the mucous membrane with fungosities and granular growths must exist to a very considerable degree.

When the probe cannot be made to pass at all into the nose, obliteration of the duct is of course to be inferred. The place of obliteration will be ascertained by the extent to which the probe can be made to pass.

It is to be remembered that in some cases complete obliteration of the lacrymal sac or nasal duct has been found to depend on exostosis of the surrounding bone. The lacrymal sac, on being opened, has been found filled up with a polypus, which was the cause of the tumour. In such a case, related by Walther, on the removal of the polypus the nasal duct wason exploration found obstructed, but was rendered permeable by the treatment.

18th.—*Treatment of obstruction of the nasal duct by operating through an external opening in the sac.*

The introduction of catguts and styles, are the means by which dilatation of the nasal duct is attempted.

The catgut as a means of dilating the nasal duct.—An opening into the sac to operate from, is to be made, if not already existing, and a piece of catgut provided, of proper thickness and sufficient length—say one inch and a half—having one end rounded and slightly softened, by being moistened, and bent abruptly at about a quarter of an inch from the other end (Fig. 168). By the rounded and softened end the catgut is introduced in the same way as a style or probe, through the opening of the sac into the duct, and pushed down in it to the nostril. The bent end is left sticking out from the opening in the sac, and by a thread attached to it and fixed to the side of the nose by court plaister, is secured from slipping in through the opening into the sac.

The catgut is much less convenient than the style, and is to be recommended only when it is desired to exert gradually increasing pressure on the walls of the duct from within. When introduced dry, and of a thickness readily admitted by the duct, the catgut gradually swells by absorbing moisture, and produces the pressure. If the catgut when dry is so thick as to be admitted by the duct, and no more, the pressure from within which ensues on the distension of the catgut by moisture, may be so great as to cause very considerable pain. This will be avoided, by so regulating the thickness of the dry catgut to the width of the duct, that the former shall be readily admitted by the latter.

The catgut is to be removed every day or two and a new bit introduced, and of greater thickness, if necessary. When withdrawn, the swollen catgut presents a more or less distinct cast of the nasal duct, and from it something may be learned as to the seat and form of any stricture or fungosity which may exist. It is to be remembered, that it will always be constricted at the places which correspond to where the sac joins the duct, and where the latter opens into the nose.

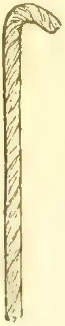

Fig. 168.

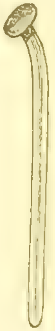

Fig. 169.

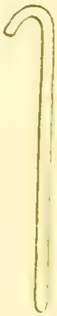

Fig. 170.

The style as a means of dilating the nasal duct.—The form and size of the style are well known (Fig. 169). It is usually made of lead or silver. One may be easily made for an occasion, by taking a bit of lead wire of the proper length and thickness, smoothing its surface, rounding one end and bending the other, thus:—(Fig. 170).

A thinner style is to be followed by a succession of thicker ones, until one of a moderate thickness can be borne; or the duct may be first prepared for the reception of a moderately thick style by the previous use of catguts, as above described.

The patient soon learns to manage the metallic style himself—a great advantage, considering the length of time the employment of means for dilating the nasal duct requires to be persisted in.

The style should be taken out frequently to be cleaned. On these occasions, some astringent lotion is to be thrown in with Anel's syringe, with a large nozzle, introduced through the opening in the sac; or the dilating body may be employed as the vehicle of some medicament, in the form of salve, with which, when about to be introduced, it is to be smeared. The bichloride of mercury collyrium, and the red precipitate ointment, are perhaps the best applications, in general, that can be made to the diseased mucous membrane of the duct. The nitrate of silver, in the form of solution or ointment, will be found advantageous when used occasionally.

When by the above described mode of treatment, which must be persevered in for at least three months in any case, but often for a much longer time, the nasal duct is dilated to its natural width, and it is believed that its lining mucous membrane is restored to something like a healthy state, the use of the dilating instruments is to be discontinued. If the transmission of the tears into the nose should now go on naturally, the opening in the sac is to be left to close.

If the tears do not continue to be freely transmitted, the treatment will require to be resumed, and if it is found, after several trials, that the employment of the style cannot be abandoned without recurrence of the obstruction, then the patient must make up his mind to wear the style habitually in the nasal duct. The inconvenience and deformity attending the habitual use of the style are small in comparison with the great benefit obtained from it.

Although the style may occupy the whole calibre of the duct when first inserted, a sufficient space is always left between it and the wall of the duct, as the mucous membrane does not tend to grasp the style as the gum grasps a tooth, but rather tends to widen around it. This shows that it is unnecessary to have the style grooved to serve as a channel for the tears, as some have recommended.

Instead of a prolonged use of the style, the introduction of a common surgeon's probe and its retention in the duct for about a quarter of an hour every day, or every second day for some weeks, has of late been preferred by Dr. Mackenzie of Glasgow. But this answers only in some cases.

Insertion of a gold tube into the nasal duct and lower part of the sac.—A plan which was in use last century, and which was revived about thirty years ago, and on the recommendation of the late Baron Dupuytren extensively but very indiscriminately practised, was the introduction of a tube, by a conductor or handle, into the nasal duct, and the closure of the opening in the sac by which it was introduced. By this proceeding we have, in cases fitted for the operation, apparently a beautiful and speedy cure. In cases in which the patient had long suffered annoyance from the complaint, I have inserted a tube into the nasal duct, and the opening into the sac has closed by the first intention in two or three days. The patient has been thus entirely relieved from all inconvenience, and been unconscious of the existence of any foreign body in the sac and duct. Moreover, I have seen the patient at the end of two years still quite well. Such is the favourable aspect of the operation; but behold the unfavourable aspect! Severe inflammation and pain come on; the swelling of the lining membrane of the nasal duct, perhaps, forces up the tube; this presses against the wall of the lacrymal sac, and an abscess forms at the place, or the tube makes its way downward into the nose—sometimes through the palate plate of the superior maxillary bone. If the tube, instead of being gold, has been silver, it may after some time fall out by the nose in black fragments.

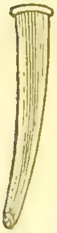
FIG. 171.

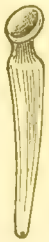
FIG. 172.

Tube.—The tube which was used by Dupuytren is of the form and size represented in the annexed cut (Fig. 171.) That originally used by Wathen is here represented (Fig. 172); and from its appearance, it may readily be understood that it would require much force to fix it properly in its place; the projection below the cup or head being of greater diameter than the duct itself; and how that in pressing the instrument into its place, the force employed may break the os unguis.

Dupuytren's tube is certainly the best. It is about an inch or so long; at one end, one-sixth of an inch wide, and provided with a rim, intended to be caught by the contraction between the sac and duct; at the other end, about one-twelfth of an inch wide, and cut obliquely. For the purpose of being introduced, it is slid on the styliform part (*a*, Fig. 173,) of the conductor or handle here represented, which fits into it so loosely, that when the tube is fixed in the duct, the conductor or handle may be withdrawn without bringing the tube along with it. The curvature of the styliform part of the conductor necessarily determines the proper direction of the tube as regards its curvature when inserted into the duct.

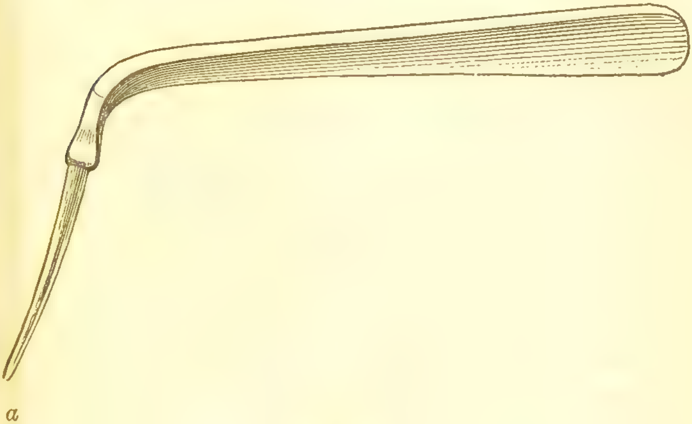

FIG. 173.

Mode of introducing the tube.—Having enlarged the opening in the sac by incision, the tube, mounted on its conductor, is to be passed into the sac, and thence slid down into the duct, its wide end remaining in the lower part of the sac, and the concavity of its curvature directed backwards. The tube is thick in proportion to the duct, as in order to be retained in its place it requires to be wedged in, and for this some force is necessary. The tube being thus fixed, the conducting handle is withdrawn from within it. The edges of the incision into the sac are then brought together by a bit of plaister.

The tears are immediately freely transmitted into the nose, and in a day or two the opening into the sac will have closed, even where there had previously been a fistulous opening. In general no further inconvenience is felt; no deformity is seen, and so the patient is dismissed cured, and may continue in the belief that he is so for years.

But it has often happened that, sooner or later, the tube has been pressed up out of its place, and caused irritation, or so much aggravated irritation, excited by other causes, that its extraction became necessary; or the bony structures round the duct having become carious, the tube has dropped out by the nose.

As a provision for the removal of the tube in case of necessity, the rim at the wide end should form a slight ledge towards the interior as it does towards the exterior, in order that it may be caught by a hook and drawn out through an opening into the sac made for the purpose. In the absence of any such provision, the extraction may in general be made by means of a dissecting forceps.

19th.—*Treatment of obstruction of the nasal duct by operating through a slit-up canalicule.*

The probing is to be repeated every day, every other day, every three or four days, or every week, according to the progress of the cure and accidental circumstances. It usually becomes at once easy for the patient to press mucus or pus from the sac as it is secreted, both by the canaliculus and nasal duct. It is common to find in a few days that no more pus is formed, and in a few weeks that mucus ceases to accumulate.

If the application of this method be restricted to the cases in which the puncta and canalicules are affected and require to be slit up at any rate, it will not prove so favourable as is here represented, but will rather come under the category of those to which the following remark of Mr. Bowman refers:

"In speaking of the rapid relief or cure of cases thus treated, I must not, Mr. B. observes, omit to say, that of course I do not neglect such general and local means as are familiar to all.

"Nor do I wish to have it thought that all cases get well at the same rapid rate, or that relapses never occur. Unfortunately these cases of obstructed ducts generally occur in subjects more or less debilitated, scrofulous or otherwise unhealthy, and there may be complications of disease of neighbouring parts, or of the Schneiderian membrane."

20th.—*Obliteration of the nasal duct.*

When on exploration it is found that the nasal duct is quite closed, but to a small extent only, a cautious attempt may be made to perforate the obliterated part by means of a stylet introduced through the opening in the sac down to the place of obliteration. If perforation be successfully effected, a style is to be inserted into the duct as above directed.

If the obliteration be to any extent, which is rare, there is not much chance of successfully perforating it; the only thing that could now be had recourse to, is the old operation of perforating the os unguis, and trying to establish a communication between the sac and middle meatus of the nose, were it not that success seldom or never crowns the attempt.

Perhaps the best palliative measure that can be adopted is to make an opening into the sac above or below the tendon and maintain it permanently. Through this opening the tears and matter accumulated in the sac may be occasionally pressed out, and thus the irritation to the eye avoided which would result from regurgitating them by the puncta.

It was the practice of the older surgeons who did not understand the anatomy, physiology, and pathology of the lacrymal organs, to attempt the obliteration of the whole lacrymal passages, on the principle of striking at the root of the disease by removing its seat.

21st.—*Lacrymal calculi.*[*]

Calculous concretions deposited from the tears have been met with, in some cases, lodged in the sinuses of the oculo-palpebral space of the conjunctiva, in other cases in the derivative lacrymal passages.

Mucocele of the canalicules has been above noticed.

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[*] Dacryolites.

CHAPTER X.

DISEASES OF THE ORBIT.

SECTION I.—INFLAMMATIONS, ETC., OF THE ORBIT.

1st.—*Inflammation of the orbital cellular tissue.*

THIS inflammation occurs in an acute or chronic form.

In the *acute* form, the *symptoms—objective, subjective,* and *constitutional*—are very much the same as those of phlegmonous panophthalmitis above described (p. 247, et seq.), but the eyeball is more protruded from the orbit, in consequence of the greater exudation into the orbital cellular tissue, and either presents no evidence of inflammation of its proper tunics, or comparatively slight ones.

In the *chronic* form, protrusion of the eyeball may have been preceded by no other symptom, or, at the most, by inconsiderable and partial pain in the orbit, during motion of the eyeball.

Inflammation of the orbital cellular tissue has a great tendency to run into suppuration. This, however, does not always take place; the inflammatory action may subside, the exuded matter be absorbed, and the eyeball return to its place; or the cellular tissue may be left in a state of induration, the eyeball, perhaps, become amaurotic from pressure, continuing protruded and motionless.

In the *acute* form, when suppuration takes place, the subjective symptoms are also much the same as in the suppurative stage of panophthalmitis, but, as may be inferred from the difference in the seat of the matter, the objective differ. The eyeball is still more protruded, but perhaps not otherwise much changed in appearance. The matter having made its way forwards, points of fluctuation present themselves either behind the conjunctiva, or behind the skin of the eyelids, or in both situations at the same time.

In the *chronic* form, that suppuration has taken place may be inferred, if the patient has experienced shiverings, &c., though suppuration may not be ushered in by any marked symptoms. As matter accumulates, the protrusion of the eyeball increases; the eyelids, red and œdematous, are distended over it, and besides diminishing vision, with photopsy and diplopy, the] patient complains of a feeling of traction in the orbit. At length, more or less obscure fluctuation is felt at some point between the eyeball and margin of the orbit.

Causes.—Inflammation of the cellular tissue of the orbit, which is a rare disease, is sometimes of traumatic origin. More frequently it appears to arise from cold in persons labouring under a bad state of health or constitution. In erysipelas of the eyelids, the inflammation is apt to spread to the cellular tissue of the orbit, and terminate either in induration or in diffuse abscess. In many cases the inflammation occurs without any very evident cause.

Prognosis.—Whether the inflammation proceed to suppuration or not, recovery with preservation of vision may take place; but, on the other hand, it sometimes happens that amaurosis is occasioned by the pressure to which the eyeball has been subjected. In the acute form there is additional risk of injury to the eye from implication of its proper tunics in the inflammation; but a still more formidable event is the extension of the inflammation to the brain or its membranes, which may prove fatal.

Treatment.—The possibility of a foreign body lodged in the orbit being the cause of the inflammation, is always in the first place to be considered.

In the acute form the same active antiphlogistic treatment above indicated for phlegmonous panophthalmitis (p. 249) in its first stage, is called for.

In the low and chronic forms, opium, cordials, and supporting diet are indicated.

When abscess has formed, the matter is to be evacuated by incision at the point of fluctuation.

If, as may happen in the chronic form, there is no fluctuation, but from the protrusion of the eye, and other symptoms, there is reason to fear that accumulation of matter in the cellular tissue of the orbit exists, an incision should be cautiously made into the orbit through the skin, between the margin of the orbit and the eyeball, in the situation where it appears most likely matter is collected. It may be necessary to extend the incision to a considerable depth—as much as an inch—before the matter is reached.

After the abscess has been opened, matter may continue to be discharged for a considerable time, though there be no disease of the bone.

2nd.—*Inflammation of the periorbita and bones of the orbit.*

This inflammation sometimes occurs in an acute form, but more frequently in a chronic, and may present itself as a primary affection, or as a consequence of inflammation of the orbital cellular tissue.

The symptoms are in general similar to those of inflammation of the orbital cellular tissue, but vary somewhat according to the part of the orbit affected, which may be the exterior margin, just within the cavity, the lacrymal fossa, the middle part of one of the walls, or the apex, and suppuration is equally prone to take place. The inflammation may, however, terminate in resolution; or, in the chronic form especially, its event may be thickening of the periorbita and bones.

When suppuration takes place, and the abscess has been opened, either by spontaneous bursting or the knife, the opening does not close, but becomes fistulous, and surrounded by fungous granulations, and on examination with the probe, the bone is felt to be in a state of caries or necrosis.

Causes.—The inflammation may be traumatic, but generally it is owing to a scrofulous or syphilitic taint of the constitution, or both at the same time.

Prognosis.—When the bones of the orbit have become diseased, exfoliation may after a time take place, and allow of the external opening closing, but the skin, already perhaps drawn in towards it, becomes still more so, and the eyelid retracted and incapable of being drawn over the eye (*lagophthalmos*, p. 662), or both retracted and everted (*ectropium*, p. 632).

Treatment.—The treatment of the acute and chronic forms of inflammation of the periorbita, and of the bones of the orbit, should be the same as that recommended respectively for the acute and chronic forms of inflammation of the orbital cellular tissue, in the purely inflammatory stage, and in the stage of abscess.

In the stage of fistula, the indication is to promote exfoliation of the bone, according to general surgical principles, and this being effected, the next point is to prevent distortion of the eyelids, or, if this has already taken place, to remove it by some one of the operative procedures described under the heads of *ectropium* and *lagophthalmos*.

SECTION II.—ORBITAL GROWTHS AND TUMOURS.

The symptoms and effects of orbital growths and tumours, are :—1. Protrusion of the eyeball in various degrees (*exophthalmus*). 2. Misdirection and displacement. 3. Impaired mobility to a greater or less extent. 4. Sometimes little or no pain, but a feeling merely of fulness, tension, and traction. Sometimes, however, more or less pain. 5. Besides diplopy, as the necessary effect of misdirection of the eyeball, impairment of vision, with photopsy, even to amaurosis, from the pressure. 6. Œdema of the eyelids, with more or less distension of the upper and eversion of the lower. 7. Sometimes eventual inflammation and disorganization of the eyeball (*exophthalmia*). 8. Dilatation of the orbital cavity, and destruction of its walls, and consequent fatal pressure on the brain, the eyeball, perhaps, continuing to resist the pressure.

Orbital growths and tumours may have their seat in the walls of the orbit or in its cavity. The growths and tumours seated in the walls of the orbit, are *node*, or *periostosis*, thickening of the bone, or *hyperostosis*, bony tumour, or *exostosis*, and cancer, or *osteosarcoma*. Those which occur in the cavity of the orbit are :—sarcomatous or fibrous, encysted, hydatidgenous, scirrhous, medullary, melanotic, and aneurismal.

Both walls and cavity of the orbit may be encroached on by tumours having their origin in adjoining cavities —the nostril, frontal sinus, maxillary sinus, sphenoid sinus, cavity of the cranium.

Causes.—The causes of orbital tumours, in general, are obscure. In many cases they appear to have formed after blows, &c., on the margin of the orbit, but often they cannot be attributed to any cause.

Treatment.—The diagnosis of orbital tumours is often very obscure. Under such circumstances the alterative mode of treatment is the only one indicated. When the tumour has become so far developed that its nature can be ascertained, what further treatment may be called for will admit of being determined.

INTRAORBITAL GROWTHS AND TUMOURS.

1st.—*Anemic exophthalmus.*

Simple exophthalmus or prominent eye occurs, depending apparently on some infiltration of the orbital cellular tissue. Such cases are met with in leucophlegmatic anemic young women, who are often affected at the same time with goitre.

On exploration of the chest, irregular action of the heart is usually also discovered.

In one case, both the exophthalmus and goitre appeared after an injury to the middle finger of the right hand—the exophthalmus in a week, and the goitre in three months. There was puffiness of the skin all round the eyes. The sight continued perfectly good for both near and distant objects.

Any connexion between the injury and the exophthalmus and goitre in this case was not very evident.

Treatment.—Iron is the medicine which has been found useful in such cases.

The spirituous solution of iodine (p. 88) may be painted over the goitre.

2nd.—*Sarcomatous and fibrous tumours in the orbit.*

When, in the case of a sarcomatous tumour, swelling presents externally, it is felt to the touch solid and resisting.

Sarcomatous tumours grow slowly, and do not in general attain any great size. They may form in any part of the orbit.

A tumour of the kind which I extirpated, had, to the naked eye, the appearance of fat, but it was much firmer and more consistent to the touch, and presented microscopical characters altogether different.

Fibrous tumours are not so circumscribed, and, therefore, do not admit of being so completely removed. After extirpation they have a great tendency to recur, though their growth may take place but slowly.

Treatment.—The only treatment applicable to such tumours is total extirpation.

The possibility of extirpating orbital tumours with safety to the eyeball and neighbouring parts, will depend on the situation, connexions, and size of the tumour. If the tumour is so connected that it cannot be wholly extirpated without the eyeball, this also must be removed, if the necessity for operation is imminent.

According to the situation and size of the tumour, so must be the situation—whether through the skin or conjunctiva—direction, and extent of the external incision, and the necessity of dividing one or other eyelid vertically, or the external commissure. If the tumour be seated in the upper part of the orbit, and appears on examination by the touch, whilst the upper eyelid is moved, to be on the orbital side of the levator palpebræ, the incision should be through the skin; but if on the ocular side, through the conjunctiva.

The external incision being cautiously but freely made, and the tumour duly exposed, it is to be seized with a hook or hooked forceps, drawn forwards, and its separation effected by careful dissection with the knife, assisted by the handle, the finger, and curved scissors, whilst the blood is assiduously removed by an assistant.

The surgeon having satisfied himself by examination with the finger that the whole tumour has been removed, allows the bleeding to stop, and then proceeds to dress the wound.

The wound is first to be carefully cleansed from clotted blood—not washed with water—and then if it admits of being filled when the eyeball is gently pressed back into the orbit, the edges of the wound are to be united by suture or plaister, or both, according to necessity. If there is a large cavity which cannot thus be filled, the wound must be kept open, but not stuffed with charpie.

Great care is required in the after-treatment. It has sometimes happened that inflammation of the orbital cellular tissue has supervened, and, extending to the brain, has proved fatal.

3rd.—*Encysted tumours in the orbit.*

When these tumours, which may originate in any part of the orbit, present themselves externally, they form between the eyeball and margins of the orbit, a rounded, equal, elastic swelling, more or less distinctly fluctuating, and yielding to pressure, so as to retire within the orbit.

The cyst of the tumour is in some cases thin and serous, in others thick and fibrous, with cartilaginiform and even ossiform depositions. The contents may be watery (*hygroma*), like suet (*steatoma*), like pap (*atheroma*), or like honey (*meliceris*). Hairs, and in one case a tooth, have been found among the contents of orbital tumours, similar to what is of more frequent occurrence in ovarian tumours.

Treatment.—Total extirpation when, from the situation and connexions of the tumour, it can be effected; if not, partial extirpation, in the hope that, by exciting inflammation on filling the cavity with charpie, the remains of the cyst may be eventually destroyed, or separated and thrown off by the suppuration. In some cases simple puncture of the encysted tumour and evacuation of its contents have been performed with success.

4th.—*Hydatidgenous cysts in the orbit.*

Cysts containing hydatids have been met with in the orbit. They presented the characters of encysted orbital tumours. On making an opening into the prominent part of the tumour, fluid was evacuated, followed immediately in one case by a large hydatid, in another case, after two or three days, by half a tea-cupful.

The following case of *echinococcus-cyst in the orbit*, which lately occurred to me, appears to be identical with those quoted by Dr. Mackenzie from Schmidt (*Ueber die Krankheiten des Thränen-organs*, p. 73; Wien, 1803), who originally described the disease, and called it *Glandula lacrymalis hydatoidea.*

A man, about 30 years of age, was brought from St. Pancras workhouse to University College Eye Infirmary, with the left eye in a state of exophthalmia. The disorganisation being great, I decided on first excising the protruding eyeball from the ocular capsule. This being effected, I proceeded to explore the orbit by the touch and found that the cause of the protrusion of the eyeball was a fluctuating cyst adhering to the upper and outer wall of that cavity and extending back towards its bottom. The removal of the cyst was accordingly the next object to be accomplished. As the first step towards this, I slit up horizontally the external commissure of the eyelids, together with the adjacent part of the ocular conjunctiva, which had been dissected from the excised eyeball. The anterior part of the cyst was thus rendered quite accessible; and all that was now required to isolate it was, to divide the cellular tissue between it and the remaining contents of the orbit—viz., the ocular muscles, capsule, &c. In the course of this stage of the operation, it was found that the cyst extended back deep into the bottom of the orbit. Thinking it therefore not advisable to follow it with the knife so far, I contented myself with removing as much of it as appeared to be safely accessible. On first opening into the cyst, a large quantity of serous fluid escaped; and on laying it further open, there was discovered what appeared to be a smaller cyst lying free in its interior.

This smaller cyst being lifted out with a pair of forceps, was found to be about the size of an ordinary plum; and proved, on examination by my assistant, Mr. Power, to be an echinococcus parent-sac, or vesicle, with its contained fluid and colony of echinococci.

The cellulo-fibrous external cyst was, lastly, dissected out to as great an extent as was considered safe.

Before applying the dressings, the wall of the orbit. where the cyst had been attached, was examined with the finger, and felt to be beset with exostotic spiculæ.

The operation being completed, the external commissure was reunited by suture, and the space left by the removal of the cyst, between the upper and outer wall of the orbit on the one hand, and the ocular muscles, capsule, &c., on the other, was lightly filled with charpie.

Suppuration from the cavity was duly established, and the healing went on favourably. The condition of the parts eventually was the same as when the eyeball is simply excised.

The patient appeared to be fatuous; and the attendant who brought him to the hospital informed us that it was sometimes necessary to confine him to the lunatic ward of the workhouse. During his residence in the hospital the man was quiet enough. Sometime after the patient was dismissed from the hospital, we were informed, on sending to the workhouse to inquire how he was, that he had been transferred to the county lunatic asylum.

The case which I have thus related appears, as I have observed, to be identical in nature with the two cases quoted from Schmidt in Mackenzie's *Practical Treatise*, pp. 101-2, under the name of encysted tumour of the lacrymal gland, or, as Schmidt himself called the disease, *Glandula lacrymalis hydatoidea*.

In Schmidt's first case, the patient died without any operation having been attempted for his relief. On examination after death, the tumour was found lying in connection with the lacrymal gland, which was smaller than usual. It was composed of an external and an internal membrane, between which there was interposed a quantity of fluid. The external membrane, or covering, consisted of condensed cellular tissue, and could not be easily separated from the scattered acini of the lacrymal gland. The internal membrane, which was very fine, semi-transparent, and filled with a limpid fluid, admitted of being freely extracted from the interior of the external covering. Schmidt, correctly enough, recognised this internal membrane as a hydatid; but darkened the subject by his hypothetical speculations concerning the origin of the tumour in the lacrymal gland. In my case, although the external cyst encroached on the lacrymal gland anteriorly, it extended to the bottom of the orbit posteriorly, and there was no indication that it was originally developed in the lacrymal gland, rather than in the cellular tissue of the orbit.

In Schmidt's second case, the tumour was punctured with a trocar passed under the upper eyelid. A quantity of clear fluid was thereby evacuated at the time, and some continued to issue from the wound for several days after. At last, on the fourteenth day, a whitish substance presented at the wound, which, being seized with a forceps and drawn out, was found to be what Schmidt recognised as an hydatid more than an inch in diameter.

This was, no doubt, an echinococcus parent-sac, or vesicle, with its contained fluid and colony of echinococci, like that extracted in my case. The size was the same.

The walls of the echinococcus-cyst were composed of an external coat, laminated, extremely tough, and of a yellowish colour, and an internal coat, rough and easily lacerated. In the clear fluid filling the cyst, Mr. Power found suspended an immense number of echinococci round cells, and detached hooklets. The echinococci, which are just visible to the naked eye, varied a good deal in length and outline; some from having the head retracted, some from having it protruded, some from being in different stages of development.

Siebold has shown that echinococci are capable of becoming developed into a species of tænia, and that therefore they may be viewed as larvæ, just as *cysticerci telæ cellulosæ* have been found to be a species of tænia in an undeveloped state.

Siebold's experiments consisted in mingling lukewarm milk with *echinococci veterinorum* and giving it to dogs. On examining the animals thus fed, after an interval of three or four weeks, Siebold found in their intestines a species of three-jointed tænia, into which the echinococci had become developed.

5th.—*Scirrhous tumour in the orbit.*

The areolar tissue near the front of the orbit sometimes becomes hard, tuberculated and scirrhous. Behind the eyeball it has been found in the same morbid condition. The whole of the areolar and fibrous tissues between the walls of the orbit and the eyeball may become infiltrated with scirrhous deposit, compressing the eyeball and protruding it from the orbit.

6th.—*Medullary tumour in the orbit.*

Medullary tumours are developed sometimes slowly, sometimes quickly, with more or less pain, &c. They are generally soft and yielding, and communicate to the touch a deceptive feeling of fluctuation, so that they are apt to be confounded with encysted tumours. Such cases are as hopeless as medullary tumour of the eyeball.

7th.—*Melanotic tumour in the orbit.*

Melanotic tumours have been met with in the orbit, either alone or in conjunction with the same disease in the eyeball.

8th.—*Aneurism by anastomosis in the orbit.*

Tumours of this kind, congenital or acquired, occur in the orbit, having either had their origin there, or being an extension of the disease from the eyelids.

The characters of such tumours are their pulsation, with whizzing noise in the head, their readily becoming diminished by pressure, and increased by excitement of the circulation.

Treatment.—Ligature of the common carotid artery has been performed with success in some cases of this disease; first by Mr. Travers, subsequently by Mr. Dalrymple of Norwich, and others. In other cases the operation has been unsuccessful.

Recent researches have rendered it doubtful whether many such cases, especially the acquired, are of an aneurismal nature at all. A case of recovery under the use of ergot is recorded by Dr. Holmes in the American Journal of the Med. Sciences, vol. 48.

9th.—*True aneurism in the orbit.*

Aneurism of both ophthalmic arteries observed on post-mortem examination, has been recorded by Mr. Guthrie.

On the subject of traumatic aneurisms of the orbit, see Mr. Nunneley's Paper in the Medico-Chirurgical Transactions, vol. 42, for 1859.

EXTRA-ORBITAL GROWTHS AND TUMOURS ENCROACHING ON THE ORBIT.

Collections of matter (pus or mucus), cysts, growths and tumours originating in the antrum, nose, frontal sinuses, &c., and, by pressure, breaking through the walls of their own cavity, may come to encroach on the orbit and displace the eyeball.

A tumour may make its way through the os unguis from the nose or antrum, and come to project in the situation of the lacrymal sac, so as to simulate a case of dacryocystitis. Epithelioma sometimes appears in this shape.

CHAPTER XI.

INJURIES OF THE EYE.

Injuries as the cause of various diseases of the eye are spoken of *passim* in the preceding pages. The treatment of the various morbid states which may be the ultimate effects of injury has also been considered. Here attention is directed to the injuries at the time of their occurrence.

Section I.—Injuries of the Conjunctiva and Eyeball.

INJURIES OF THE CONJUNCTIVA FROM INTRUSION OF FOREIGN BODIES INTO THE OCULO-PALPEBRAL SPACE.

The intrusion of foreign bodies into the oculo-palpebral space of the conjunctiva, their removal and the applications necessary in the first instance have been above treated of (p. 92, et seq.). Here the injury occasioned, and its treatment come to be considered.

1st.—*Mechanical injuries.*

The inflammation which supervenes on the mechanical irritation or injury done to the conjunctiva, by the intrusion of foreign bodies into the oculo-palpebral space, or by simple wounds or abrasions of the membrane by whatever means produced, differs very much in different cases, both as to seat and as to nature and severity. Sometimes the inflammation is confined to the conjunctiva, sometimes it is internal; sometimes less, sometimes more severe, and that irrespective of the severity of the injury. When conjunctival, the inflammation may present the scrofulous character or it may be puro-mucous.

These differences, though they may be determined in some degree by the nature of the injury, depend also very much on the age and constitution of the patient.

Treatment.—See Traumatic Ophthalmia, p. 256, et seq. It is to be here observed that a certain degree of inflammatory congestion is excited by an injury, and will continue until the healing process is completed, being a necessary condition for the supply by exudation of the lymph necessary for that purpose (p. 98). It is vain, therefore, as well as improper to attempt the resolution of this due degree of inflammation. It is only to moderate undue inflammatory action that interference is called for. The distinction between *due* and *undue* must be learned by experience under the guidance of the principles previously laid down.

2nd.—*Chemical injuries.*

According to their degree of concentration, and the length of time they have been allowed to remain in the eye, bodies chemically active may simply excite more or less severe inflammation, internal as well as external; or may at once produce very material organic injury, which is of course also followed by inflammation.

That the conjunctiva can bear a great deal in this way is proved by the strong irritants,—such as nitrate of silver ointment, or even nitrate of silver in substance,—frequently applied to it by way of treatment, and by the circumstance that melted pitch, tallow, and even lead, have fallen into the eye, without any bad ultimate result. In some cases, however, the effects of the action of such agents are both severe and destructive.

The chemical agents, the intrusion of which into the eye not unfrequently occurs, are lime, mineral acids, and the like, or burning hot substances.

Lime.—According as it is in the state of quick lime, slaked lime, or mortar, and according to the quantity intruded into the eye, and the length of time it has lain there, so will be the extent of the injury.

Quick lime is very fatal to the eye. Not only is the epithelium of the conjunctiva and cornea immediately decomposed, but their proper substance may be more or less completely destroyed, and the eye for ever rendered useless.

Slaked lime does not produce such immediate mischief. The conjunctiva and cornea are thickened, and rendered of an opaque white appearance from decomposition of their epithelium, wherever they have been directly acted on by the caustic. Sloughs of the conjunctiva may be formed, and thrown off, leaving the sclerotica or tarsal cartilage exposed, as the case may be.

The conjunctiva is white at the places where the lime has acted most severely,—it elsewhere presents vascular injection and small spots of extravasation of blood. The conjunctiva is of a peculiar red and white marbled appearance.

The decomposed epithelium peels off in opaque white flakes. Over the cornea, it first rises in a blister, and when it has peeled off, the proper substance is left smooth, but somewhat opaque, and vessels soon form in it.

If the action of the lime have not extended to the proper substance of the cornea, and if the inflammation which follows is moderate, the transparency of the cornea may, when the epithelium is regenerated, be gradually restored in a greater or less degree, but vascularity of the structure will probably remain.

If the lime have acted more deeply, or if severe inflammation has ensued, the cornea may never again become clear.

Sulphuric acid.—This has been sometimes thrown into the eyes of persons with the criminal intention of destroying sight. In such cases, besides the injury to the face and eyelids, the conjunctiva appears almost scarred, being white, soft, and swollen. It afterwards peels off, while the cornea rapidly becomes disorganized by infiltration of pus, ulceration, and sometimes sloughing.

Though the immediate effects of the injury may not be to such an extent as the above, Dr. Mackenzie remarks that dangerous symptoms, such as onyx and iritis, are apt to occur in such cases, weeks after the receipt of the injury. Sympathetic ophthalmia, also, is liable to occur.

Symblepharon, either mediate or immediate, and to a greater or less extent, is a common effect of injury of the conjunctiva by caustic substances. The corresponding surfaces of the eyeball and eyelid having been left raw by corrosion, ulceration, or sloughing, unite directly, or, what remains of the conjunctiva is, in cicatrizing, drawn together.

Burning hot substances.—Burns blister the conjunctiva and cornea, and sometimes excite very destructive inflammation.

When gunpowder is exploded against the eye, besides the burn which takes place by the flame and the grains in a state of ignition which are projected against the organ, unexploded grains, when the gunpowder has been confined, as in a flask, are apt to be projected against and to fix in the skin of the eyelids, the conjunctiva, and the cornea. A grain has even penetrated right through the cornea.

Treatment.—The removal of caustic or burning hot substances, whether solid or fluid, and grains of gunpowder, and the treatment in the first instance, have been above considered (p. 92).

To moderate the inflammatory reaction as much as possible, the patient must be kept at rest, and his bowels opened; blood should be abstracted by venesection or leeches, and the eye covered with cold lotions.

The inflammation which supervenes must be treated according to its nature and severity. Most commonly the inflammation is puro-mucous conjunctivitis.

INJURIES OF THE EYEBALL AND ITS PROPER TUNICS.

1st.—*Concussion of the eyeball.*

Amaurosis is a not unfrequent consequence of even very slight blows on the eyeball, with or without any visible injury of the organ.

Blows, contusions, and wounds of the eyebrow and margin of the orbit, without any visible injury of the eyeball, may also occasion amaurosis. In such cases the amaurosis is considered to be owing to concussion of the retina (p. 542), though most probably to extravasation of blood. A case of laceration of the retina and choroid from the splinter of a shell striking the temple is related above (p. 59).

As in wounds of the eyebrow, the frontal branch of the fifth nerve is often injured, the opinion has been entertained, that the amaurosis is in some manner connected with that injury rather than concussion. Although this can scarcely be admitted as regards amaurosis immediately consequent on the injury, it is by no means unlikely that injury of the fifth nerve, by determining slow internal ophthalmia, may prove a cause of the amaurosis, which sometimes comes on subsequently to the injury.

Treatment.—For the treatment of the amaurosis from concussion of the eyeball, see p. 549.

The effect of a blow on the eye may be evident internal inflammation with amaurosis, probably from extravasation of blood implicating the retina. A man received a box on the eye: when seen a few days after, there was found circumcorneal injection, both sclerotic and conjunctival; the colour of the iris changed, and the pupil dilated. He could not recognise a person, but could just see that there was something before him.

Venesection to ℥xij., and one grain of calomel three times a day, were ordered.

A few days after, the inflammation was much diminished, and the sight so far improved that the patient could now recognise a person before him.

2nd.—*Contused wounds of the eyeball.*

The eyeball bears simple incised wounds very well, but not contused wounds. Injuries of this kind, in fact, are very dangerous.

In injuries of the eyeball from contused wounds, occasioned, for example, by small shot, fragments of percussion caps, &c., striking it, even without penetrating into its interior, if blindness from attending concussion should not be the immediate effect, it will generally be eventually occasioned by the destructive internal inflammation which supervenes. But in addition to this, the uninjured eye is, as above shown (p. 256), very prone to become similarly affected with internal inflammation.

In cases in which small shot, fragments of percussion caps, &c., have penetrated and lodged in the eye, the effect is often persistent inflammation and disorganization of the organ with severe pain.

A young gentleman was brought to me from Wales who had received a wound of the eye from the projection of fragments of a percussion cap against it. There was a wound at the margin of the cornea with prolapsus iridis. The iris was quite green. With the inflammation there were severe pain and intolerance of light. Sight was lost, but there was photopsy.

I excised the eyeball, and in a few days the boy recovered his health and spirits, which had begun to fail him.

On examination of the excised eyeball, I found a small fragment of cap imbedded in the ciliary zone. The posterior chamber was filled with lymph. The retina was detached and crumpled together by effusion of blood and serum between it and the choroid.

3rd.—*General extravasation of blood in the eye from injury.*

Reference is made under the head of Hæmophthalmus at p. 309 to this place for a notice of extravasation of blood in the eye from injury.

Sometimes the aqueous humour is so mixed with blood, that the cornea presents a deep uniform chocolate hue, through which neither pupil nor iris can be seen.

The posterior segment of the eye may be also infiltrated with blood and disorganised. That this has taken place cannot, however, be determined at first, though from the severity of the injury it may be suspected.

Sometimes the bottom only of the anterior chamber seems to contain effused blood; but if the pupil be dilated by atropia and examined with the ophthalmoscope, deeper seated extravasation may be detected.

In the less severe injuries, the effused blood becomes absorbed and sight is regained.

In the more severe injuries the eye becomes atrophic.

It is sometimes found necessary to excise the injured eye, on account of its continuing the seat of pain, or on account of the opposite eye being threatened with sympathetic ophthalmia.

4th.—*Injuries of the cornea.*

Foreign bodies imbedded in the cornea.—The removal of foreign bodies adhering to the surface of the cornea, or imbedded merely in its conjunctival layer, has been above treated of. Here foreign bodies imbedded in the substance of the cornea fall to be considered.

Chips of pure metal, splinters of glass, stone, hard wood, and the like, projected against the eye, often stick, more or less deeply, in the cornea, or even wholly penetrate it, and lodge in the interior of the eye. If a part of the foreign body remains projecting, very great irritation ensues, but if the body has sunk fairly in the substance of the cornea, it may produce little reaction, or, becoming enveloped in a capsule of lymph, may cease to be a cause of irritation, and the inflammation, to which it has given rise, subside; the cornea at the part remaining opaque. More frequently, however, ulceration of the cornea takes place around the foreign body, which thus becomes loose at the bottom of the ulcer, requiring but a touch for its detachment.

When a chip of iron sticks in the cornea, and is allowed to remain any time, it becomes oxidated, and tinges the adjacent cornea of a brown colour.

If any part of a foreign body which has penetrated the substance of the cornea projects, it is to be seized with a forceps and drawn out; but if it does not project, it is necessary to use a pointed instrument, such as a large and rather blunt cataract needle for its dislodgment. In doing this, great care should be taken not to cause any abrasion of the cornea, and never to scrape it, with the intention of removing, for instance, the brown speck left by the oxidation of a fragment of iron—such a speck it is well not to interfere with.

When the foreign body is irregular in shape, and has penetrated the cornea obliquely, and to some extent, it may be necessary to make an incision with a cataract knife, so as to expose the body, which is then to be seized with a forceps, or turned out with the spatula.

Abrasions of the cornea.—Though the surface of the cornea may be touched without inconvenience, a sudden wipe on it, with a handkerchief, for instance, causes considerable uneasiness, lacrymation, and intolerance of light for a time.

Abrasion of the cornea is sometimes produced by a scratch of the finger nail, or by awkward attempts to remove a foreign body; or it is the result of a stroke with a twig, or with an ear of corn, an accident to which reapers are much exposed.

Punctured and incised wounds of the cornea.—The puncture or incision made in the cornea in operations generally heals soon and kindly; and even wounds produced by accident sometimes heal beyond expectation, though they are not unfrequently followed by severe and destructive inflammation. Such a result is readily accounted for by the contusion of the whole eye attending the accident, by the irregularity of the wound, perhaps a bad state of health at the time, and not unfrequently by the neglect with which the case is apt to be treated at first.

The immediate effect, in cases of penetrating wounds of the cornea, is escape of the aqueous humour, and, sometimes, protrusion of the iris. It is this latter circumstance, when it occurs, which constitutes the principal difficulty of the case, for the mere wound of the cornea may heal, and the aqueous humour be renewed in from thirty-six to forty-eight hours. Even when the accident is quite recent, it is seldom we succeed in returning the iris to its natural position—never, if but a few hours have elapsed.

If the iris be but slightly engaged in the wound of the cornea, and if this be towards the circumference, the first thing to be tried is the application of the Calabar bean drop or gelatine (p. 83). The tendency of the pupil to contract being thus excited, disengagement of the iris from the wound of the cornea is expected to follow. This proceeding may be aided by attempts to push the iris back into its place with a blunt probe. But, of course, all this would be useless if the iris were at all strangulated in the wound of the cornea.

If the wound of the cornea be nearer the centre, and if it be the pupillary portion of the iris which is prolapsed, dilatation of the pupil by belladonna, prejudicial in the former case, may be tried in this.

In regard to exciting the pupil to contract or dilate, it is to be remarked, that though the contractile power of the iris appears very considerable while supported by the aqueous humour, it becomes almost null when this is removed, in consequence of the resistance of its own weight, and the pressure of adjacent parts, to say nothing of its engagement in a wound of the cornea.

If protrusion of the iris be evidently kept up by the aqueous humour pressing it forward, this should be evacuated by puncture.

If the attempts to return the iris have failed, and if the case be still recent, the protruding iris should be snipped off with scissors, especially if it be the pupillary edge, and then friction employed as before. By this proceeding we may preserve the cornea entire, though with a pupil large and irregular. By leaving the iris protruded, synechia anterior and contracted pupil, with opacity of the cornea to a greater or less extent, if not partial staphyloma, inevitably result.

If some time has already elapsed since the accident, the case falls into the category of ophthalmia, attended by penetrating ulceration of the cornea, and protrusion of the iris.

A penetrating wound of the cornea, at its margin, sometimes closes by the conjunctiva alone healing over it, while the proper substance of the cornea remains ununited. The consequence is, the aqueous humour elevates the conjunctiva in the form of a vesicle. This state of parts is called *fistula corneæ*, and must be distinguished from hernia corneæ and partial staphyloma.

A man, thirty-eight years of age, came under my care, on account of a sudden amaurosis of the right eye from extravasation of blood implicating the retina. At the age of four years this individual received a penetrating wound of the left eye, of the kind under consideration. At present a vesicle still forms now and then at the seat of the wound.

After snipping off the elevated conjunctiva, the orifice in the proper substance of the cornea, leading into the anterior chamber, is to be touched freely with the lunar caustic pencil, or, as above mentioned at p. 387, the pointed nitrate of silver pencil may be thrust into the vesicle without any previous puncture.

Treatment of inflammation excited by injury of the cornea.—The inflammation may be very slight, and readily subside by rest, cold lotions, and antiphlogistics.

The result of injury of the cornea, however, even when trifling in degree, is not always so slight. The inflammation is sometimes severe, obstinate, and dangerous, involving not only the cornea itself, but also other parts of the eye, both external and internal. The membrane of the aqueous humour is particularly liable to suffer; and iritis on the one hand, and inflammation of the proper substance of the cornea, ending in purulent infiltration, on the other, are not unfrequent complications. Sometimes the posterior segment of the eyeball becomes involved.

5th.—*Inflammation from abrasion of the cornea.*

A severe form of inflammation is often met in consequence of abrasion of the cornea, though a similar inflammation may arise from other injuries of the cornea. The patient presents himself to the surgeon with the cornea muddy, the iris discoloured, the pupil contracted.

and considerable conjunctival and sclerotic injection, such as is seen in catarrho-rheumatic ophthalmia (p. 208, et seq.). These objective symptoms are accompanied by fever, severe circumorbital or temporal pain, aggravated at night, and dimness of vision.

If the inflammation be allowed to run on, or if treatment fail to arrest its progress, purulent infiltration of the cornea, hypopyon, and effusion of lymph into the pupil, may take place singly or together. The ultimate result is loss of the eye, either by the bursting of the cornea, and the formation of staphyloma, or by atrophy.

In such a case mercury is our principal remedy, after the abstraction of blood. The extent to which venesection should be carried ought to be carefully regulated by the circumstances of the case; it is not to be dreaded too much on the one hand, nor, on the other, pushed, by repetition, too far. The pupil is to be kept dilated by belladonna lotion or the solution of atropine: and when the progress of the inflammation is arrested, the exhibition of bark, as a general remedy, and the application of the drops of the bichloride of mercury with vinum opii (p. 83) as a local remedy, will powerfully promote the cure.

A woman, æt. 46, received an injury of the left eye from her husband's finger being thrust into it. On the second day after, the surface of the cornea was found abraded, and there was considerable conjunctival, together with some circumcorneal sclerotic injection. The iris was somewhat discoloured and the pupil contracted.

The patient complained of great pain in the eye over the eyebrow and in the temple, of the same side, and in addition pain still more severe over the eyebrow of the opposite side; the pain shot to the back of the head.

Calomel (gr. iij.) and Dover's powder (gr. viij.) were ordered to be taken at bed-time, and black draught next morning; after that, calomel (gr. j.) and Dover's powder (gr. ijss.) three times a day. The belladonna lotion to be used for fomenting the eye with.

Under this treatment improvement took place, and I saw nothing more of the patient for a month, when she returned complaining that; three nights before, she awoke with dreadful pain in the left eye and temple, and across to the other side. On examination, I found conjunctival and sclerotic injection, with a small ulcer nearly in the middle of the cornea; the iris discoloured and the pupil somewhat contracted. She was suffering sharp pain in the eye, apparently from the ulcer of the cornea; also, circumorbital and temporal pain extending from the left to the right side.

Venesection was ordered and a repetition of the calomel and Dover's powder at bed-time, with black draught next morning, and after that calomel (gr. j.) and opium (gr. ¼), three times a day.

She bore the abstraction of ℥xij. of blood well.

On the third day after this, the report was—"Eyes almost well to-day."

A man, æt. 45, was under my care some years ago, on account of an injury to the left eye, occasioned by an infant thrusting its finger into it, and abrading the cornea, and on which inflammation of a catarrho-rheumatic character supervened.

Subsequently he suffered a similar injury, which was followed by similar symptoms. The vascular injection of the eye was slight, but the circumorbital pain was very severe.

Had been subject to and was then suffering from rheumatism.

To take calomel (gr. iij.) and Dover's powder (gr. x.) at night, and black-draught next morning.

Two days after this, the eyes were found much better. No marked vascularity. The circumorbital pain gone: merely some slight pricking pain over the eye. The rheumatic pains principally confined to the head. To take the alkaline colchicum mixture.

A boy, æt. 5. The finger of an infant was accidentally thrust into his right eye. On examination, the indented mark of the finger nail was observed about the middle of the cornea, the pupil was considerably contracted, there was great intolerance of light. The child did not complain much of pain.

Two leeches to the eye were ordered, and a powder consisting of hydrarg. c. creta and rhubarb.

When the patient was next seen, the eye was found much better, the vascularity diminished, the intolerance of light less, and the pupil no longer so much contracted.

6th.—*Foreign bodies in the aqueous chambers.*

Foreign bodies may penetrate right through the cornea and remain lodged in the anterior chamber, often at the same time sticking in the iris or crystalline. Eyelashes have in several instances been driven in through a wound of the cornea: some of these cases have been described as examples of development of hairs within the eye.

If the wound in the cornea be large enough, an attempt may be made to extract the foreign body through it by means of the small hook or forceps delineated at page 392. If not large enough, and if so placed that enlargement of it would not be advisable, a clean section of the cornea near its margin should be made, of the necessary size, and on the side where it appears the foreign body will admit of being most readily seized. It sometimes happens that, on section of the cornea, the foreign body escapes along with the aqueous humour, when this has not been previously evacuated.

Foreign bodies, though not extracted, may cease to cause irritation by becoming inclosed in a capsule formed of lymph deposited around them; or, in the case of small particles of iron or steel, as the point of a cataract knife or needle accidentally broken off during operation, they may become oxidised and dissolved.

A lad, æt. 14, seven or eight years ago accidentally thrust a small shoemaker's knife into the right eye, at the upper and outer edge of the cornea. The wound implicated the sclerotica and extended halfway across the cornea. The lens had been wounded, and prolapsus iridis taken place. On examination, the iris was found dragged up towards the cicatrice, behind which the contracted pupil was partly hid. By looking from below a piece of opaque capsule in the pupil could be seen. The iris was tremulous, and on the anterior surface of its lower part there lay an eyelash directed from above, downwards and inwards. The former free extremity of the hair appeared to be implicated in the cicatrice, and the root part was that which was directed downwards and inwards to within one-twentieth of an inch of the ciliary margin of the iris. The little black point of the bulb and the white part above were still quite appreciable. The hair was of the same colour as the existing eyelashes, except that it was rather redder. It shook with every motion of the iris. The eyeball as a whole was enlarged and vision quite gone.

In a man who had five or six years before had a piece of percussion cap projected into his eye, I found it attached to the iris, near the pupillary margin, by lymph without causing any irritation. The capsule of the lens had been wounded and the lens absorbed.

Foreign bodies which have penetrated through the cornea into the lens or deeper, may sometimes be got hold of through the still open and suppurating wound and extracted.

7th.—*Injuries of the iris and pupil.*

Along with the cornea, ciliary body, crystalline lens, and other parts of the eye, the iris may be implicated in punctured, incised, and lacerated wounds.

By smart strokes on the eye, the iris is apt to be separated from its ciliary attachment.

The iris may be lacerated across in its whole breadth, and at the same time separated to a greater or less extent from its ciliary attachment.

Great and irregular dilatation of the pupil sometimes occurs, from the iris being on one side wholly displaced to behind the sclerotica.

All these injuries may be attended with more or less effusion of blood and impaired vision.

Such injuries, it will be observed, are similar in their nature to those inflicted either accidentally or intentionally in various operations on the eye, or which occur in disease, as above described.

Thus, when an opening is made in the iris, it gapes, and remains as a false pupil. When the iris is separated at some part of its ciliary circumference, the result also is a false pupil. When the iris is torn across there is produced a state resembling coloboma iridis. Lastly, when the iris is displaced on one side to behind the sclerotica, so as no longer to be visible through the cornea, a state of pupil is presented similar to that which often occurs in posterior internal ophthalmia and choroid staphyloma.

Prognosis and treatment.—See *Traumatic Ophthalmia*, p. 256.

8th.—*Injuries of the crystalline body.*

The crystalline body is liable to suffer from two kinds of injuries. It may be directly wounded by a foreign body or instrument which has penetrated the eyeball; or it may have its connection so broken up in consequence of a blow upon the eye or its neighbourhood, that it becomes opaque. In this latter case the capsule may or may not be burst.

Wounds of the crystalline body, even when simply punctured or incised, give rise generally, though not invariably, in the human eye to lenticular opacity, and often to more or less capsular opacity in the seat of the wound. After a wound or rupture of the capsule, the soft exterior part of the lens is sometimes seen to ooze out in the form of a semi-opaque flock.

The wound of the capsule, if small, may unite and the opaque lens remain; but when, by reason of its extent, the wound does not close, the lens is gradually dissolved, and disappears, as after the operation for cataract by division. In such a case the injury is both bane and antidote.

The wound of the eye, of which that of the crystalline is merely a part, is usually followed by an attack of internal inflammation, sometimes very severe and destructive. This may take place even after needle-operations for cataract in which the wound is as simple as possible. The membrane of the aqueous humour and the iris are, in the least complicated cases, the parts commonly most affected; and the consequence is, effusion of lymph into the pupil.

Sometimes a wound of the capsule is followed by dislocation of the lens into the anterior chamber, an accident which occasionally happens during needle-operations for cataract. The capsule may also be burst by a blow, and the lens forced out of its situation.

The extent to which the crystalline is removed from its place has been found to vary in different instances. It may be merely so far separated from its connections, as to press the iris forward, and thus obliterate the posterior chamber and diminish more or less the anterior, or it may be entirely dislocated into the anterior chamber. Cases again have been met with in which the lens has escaped through a breach in the cornea, from a blow, or, having been forced through a laceration in the sclerotica, has been found lying underneath the conjunctiva.

The capsule may accompany the dislocated lens; but this will seldom be the case in a previously healthy eye, because the connections of the capsule are everywhere so close. A young gentleman was struck on the eye with a racket ball; the effect of the blow was laceration of the connections of the capsule on the temporal side, and a dislocation of the crystalline body back into the vitreous. The pupil became much dilated, and continued so. The dislocated lens was removed by the operation of division, but the sight was imperfectly regained. It more frequently happens, that the connections of the capsule having gradually become dissolved in consequence of some slow morbid action in the interior of the eye,—the result, sometimes, of no particular cause, sometimes of a blow previously received—the slightest concussion is sufficient to cause dislocation of both it and the lens. In such a case, as a dissolved state of the vitreous body is a frequent concomitant change, the dislocated crystalline may fall back into it, or through the pupil into the anterior chamber. Sometimes the connections of the crystalline not being wholly broken up, it remains *in situ*, but is tremulous; or it is retained at some part of its circumference merely, and there moves as a door on its hinges. In a midshipman, in whom the crystalline body was partially dislocated back into the vitreous humour by the thrust of a foil, and for which nothing had been done, I found matters in this state.

A dislocated crystalline very generally becomes opaque, but not always; for instances are related, not only of a lens and its capsule, but also a lens alone, being dislocated into the anterior chamber, and remaining there for some time without losing transparency. Fig. 2, Plate V.

It generally happens in those cases in which the connections of the crystalline are slowly dissolved, that opacity also takes place. This is called *cataracta cystica*; and as it is seen bobbing up and down, or floating in the dissolved vitreous humour, the epithet *tremulans* or *natatalis* is sometimes superadded. A cystic cataract may occasionally fall through the pupil into the anterior chamber, and again slip back.—See farther on this subject the section on Cataract (p. 338).

Treatment.—Wounds of the crystalline body are not of themselves the immediate subject of treatment, but it is the internal inflammation, which is so apt to result, that requires to be carefully attended to. A dislocated lens is frequently the cause of keeping up inflammation, and ought to be extracted; and this, even though there should be no irritation at the time, if from its hardness it is not likely to be absorbed; because, acting as a foreign body, it is apt sooner or later to give rise to inflammatory action.

The propriety of removing a lens forced out of the eyeball through a rent in its coats, and lying under the conjunctiva, is obvious, but interference in other cases will depend on the existing circumstances.

A sportsman, æt. 49, in passing over a style received a stroke on the cornea from a rebounding twig. The result was some degree of iritis. When he consulted me I detected opacity of the lens, but no rupture of the capsule.

A countryman, æt. 50, in passing through a wood received a similar stroke, whereby the upper part of the capsule was burst and the lens somewhat displaced upwards, so that it pressed on the iris. In this case, I considered it advisable to lacerate the capsule more freely by operation.

A boy, æt. 13, suffered a similar injury. In this case, the capsule was more freely lacerated by the stroke. The lens became opaque, broke up of itself, and was quickly absorbed. The pupil became quite clear. The iris continued lively. The vision as good as it ever is after the loss of the crystalline.

A man, about 24 years old, was hacking wood, when a splinter flew up and struck the eye, causing a penetrating wound of the cornea, next its lower and inner margin. The effect of this was considerable prolapsus iridis, and inflammatory reaction. The lens also became opaque, but the capsule was not burst.

A man, about 30 years of age, healthy but not strong: in attempting to take a nail out of a board with a screwdriver, the instrument slipped and struck his right eye; the result was that his spectacles, which he had on at the time, were broken, and a vertical penetrating wound of the cornea inflicted. As appeared afterwards, the capsule of the crystalline lens was also lacerated,—probably, however, in consequence of being burst by the blow rather than directly wounded by the instrument. After three weeks homœopathic treatment the patient came under my care, when I found the eye in the following state:—

There was a large quantity of lymph on the posterior surface of the cornea in the situation of the wound, and thence extending into and filling up the pupil. The pupillary margin of the iris at its outer part was adherent to the cornea in the situation of the wound. The pupil being so much filled with lymph, the state of the lens could not be at first ascertained.

The vascularity of the white of the eye was chiefly limited to circumcorneal sclerotic injection. The iris was of a deep green colour.

The patient had suffered very little pain.

A pill of calomel gr. ij., and opium gr. $\frac{1}{4}$, was ordered to be taken three times a day, and the eye to be bathed occasionally with tepid water.

At the end of four or five days the mouth had become slightly affected by the mercury, and the circumcorneal sclerotic injection and greenness of the iris much diminished, whilst absorption had so far cleared away the lymph that a part of the pupil could now be seen.

The report four days after the last, *i. e.*, about eight days after the commencement of the allopathic treatment, states the mouth to be much affected by the mercury—the natural colour of the iris reappearing—and the lymph on the posterior surface of the cornea and in the pupil still further diminished by absorption, so that more of the pupil was visible.

The pupil was found somewhat contracted and displaced inwards, in consequence of the implication of the outer part of the pupillary margin of the iris in the wound of the cornea.

Consistence of the eyeball natural.

Perception of light much stronger.

To intermit the calomel and opium.

According to the next report, three days after the last, *i. e.*, about eleven days from the commencement of the mercurial treatment, the inflammation was still diminishing, and the absorption of lymph so far advanced, that the pupil was now cleared of it so as to allow of the state of the lens being ascertained. It was then discovered that the capsule had been lacerated by the injury, and that the lens had in consequence become cataractous.

Ten days after the last report, *i. e.*, after about three weeks' allopathic treatment, the circumcorneal sclerotic redness was almost gone, and the iris nearly of its natural colour. The wound of the cornea healed and free from lymph. The cataractous lens becoming absorbed.

Fourteen days after the last report the eye looked well. The redness of the white of the eye around cornea almost gone. Iris natural-looking, with the exception of the slight synechia anterior; pupil of natural size, and contracts or dilates according to the degree of light.

Cataractous lens slowly disappearing by absorption.

Seven weeks after the last report the lens was quite absorbed, and the pupil black. Two slight points of anterior synechia, one at the lower and outer, and the other at the upper and outer, margin of the pupil.

Sees with a cataract glass.

9th.—*Wounds of the sclerotica and posterior segment of the eyeball.*

The tunics being divided, there is a tendency to protrusion of the vitreous body, with escape of its fluid, effusion of blood, and, perhaps, protrusion of the internal tunics, and even escape of the lens.

By blows on the eye, the sclerotica, but not the conjunctiva, may be ruptured; besides this, there is necessarily more or less serious injury to the other parts of the posterior segment of the eye, such as extravasation of blood within the organ, laceration and protrusion of the internal tunics, escape of vitreous humour, sometimes of the lens, which is found under the conjunctiva.

Treatment.—Nothing more can be done in such cases than to keep the patient at rest, with his eyelids closed, and covered with cold applications, and to meet inflammation as it arises. See Traumatic Ophthalmia. The eye usually becomes atrophic.

A boy was struck in the eye by an arrow. The sclerotica was pierced behind the upper and inner edge of the cornea. Protrusion of the ciliary body with dragging of the iris took place. The inflammatory reaction which followed was not very severe. The eye became atrophic.

A girl had an iron spike thrust through the sclerotica, the effect of which was persistent inflammation. The other eye beginning to sympathize, the injured one was excised, and, on examination, the retina was found wholly detached by effusion of serum between it and the choroid.

In the case of another girl who suffered a similar injury, there was little inflammation or pain, and the eye became atrophic. The opposite eye continued sound as long as she was under my notice.

A woman, æt. 30, received a blow on the right eye. There was great extravasation of blood under the ocular conjunctiva, so that it was raised up somewhat like chemosis around the cornea. There was also extravasation of blood into the aqueous chambers, so that the iris could not be seen. Leeches were applied, and aperients administered, after which the pain was relieved, and absorption of the effused blood commenced. A week after, the blood had so far disappeared from the aqueous chambers that the iris and pupil could be seen. The subconjunctival ecchymosis was also removed to a considerable extent. At the upper part of the eyeball the conjunctiva was now seen to be elevated by something underneath. This was probably the lens burst through a rent in the sclerotica, especially as on examining the eye catoptrically, no lenticular images were seen. The patient did not again come under observation.

The yellowish opaque deposition, sometimes traversed by bloodvessels, at the bottom of the eye, which is a not unfrequent result of injury of the eyeball, especially of its posterior segment, has been above described under the head of non-malignant tumours (p. 322). Sclerotic staphyloma, atrophy of the eyeball, a shrunk state of the same from loss of humours and the like, have also been referred to, as not unfrequent eventual consequences of injury of the eyeball (pp. 280, 283, 284).

10th.—*Dislocation of the eyeball.*

Foreign bodies forced in between the eyeball and the wall of the orbit, may cause protrusion of the former. The foreign body being removed, pressure on the eyeball, continued, steady, but gentle, will effect reduction of it: sometimes with a jerk. Vision, which had been lost from the stretching of the optic nerve and pressure on the eyeball, is on reduction sometimes quite restored.

11th.—*Evulsion of the eyeball.*

The eyeball, with a portion of the optic nerve, has been completely torn out of its socket by a cart-wheel going over the side of the man's head. Recovery took place. The eyeball may be blown out by a musket-shot.

SECTION II.—INJURIES OF THE EYEBROW AND EYELIDS.

1st.—*Contusion, with ecchymosis.*

The effect of contusion of the eyebrow and eyelids is at first swelling, which, after a few hours, is followed by ecchymosis or extravasation of blood into the substance of the dermis, causing discoloration of the parts, or what is called a black eye. In severer cases of contusion, there is effusion of blood into the subcutaneous cellular tissue also.

Subconjunctival ecchymosis is often occasioned at the same time by contusion of the eyebrow and eyelids. Extravasation of blood may even take place into the orbital cellular tissue, occasioning some degree of exophthalmos.

Ecchymosis of the subconjunctival tissues and eyelids is a sign of great importance, after an injury about the head, as it may indicate a fracture of the base of the skull through the orbital plates.

Treatment.—If there is effusion of blood into the subcutaneous cellular tissue, it is to be evacuated by puncture. When the contusion is severe, it will be necessary to apply leeches and cold lotions to keep down inflammation. In simple cases, cold lotions alone may be sufficient.

The discoloration from ecchymosis disappears as the blood is absorbed; but as this takes place slowly, various applications are made in order to hasten the process. A cataplasm of the grated roots of convallaria, or Solomon's seal, is a popular and efficient remedy, renewed every half hour for several hours. It occasions considerable redness and œdema of the skin, with smarting. A solution of the hydrochlorate of ammonia (Ammon. hydrochlorat. ℥j., aq. distillat. ℥xiv., Spiritus ten. ℥ij.) is also a useful remedy for the purpose. Likewise a vinous infusion of Arnica flowers and rosemary (āā ℈iv.) in wine (℥iv).

2nd.—*Incised, lacerated, and contused wounds of the eyebrows and eyelids.*

It must be recollected, in attending to wounds from a contusion of the upper eyelid, that, as observed by the

American editor of this work, the injury is generally worse than would be supposed from the effect upon the skin. The acting power is the sharp orbital edge of the frontal bone, and the soft parts are torn from within, towards the skin; so that the more deeply seated tissues are sometimes greatly injured when the skin is scarcely touched. See the remarks and case at p. 3.

Wounds of the eyebrows and eyelids are to be carefully united by suture. When, in consequence of the wound being lacerated and contused, union does not take place by the first intention, great care will be necessary during the process of granulation—unless there be loss of substance, when healing by a broad cicatrice is rather to be attempted (p. 626)—to keep the edges of the wound drawn toward each other, and in a proper direction, with strips of plaister, so as to ensure as regular a cicatrice as possible.

It is always to be kept in mind, that one great point in the treatment of wounds of the eyebrows and eyelids, is to prevent distortion of the eyelid, such as ptosis on the one hand, or lagophthalmos or ectropium on the other, taking place from irregular cicatrices. See above under their respective heads, the treatment of such distortions when they have taken place.

If no undue inflammation supervenes, wounds of the eyebrows and eyelids readily heal. Even when lacerated or contused, little suppuration may take place, and but a slight scar may be left, without injury to the eyelid. Undue inflammation, phlegmonous or erysipelatous, may, however, come on. In this case, the wound must be left open and covered merely with water dressing until the inflammation has subsided.

In wounds of the upper eyelid, as above mentioned (p. 665), the levator muscle may be divided, and ptosis thereby occasioned.

A fissure of the eyelid, like a button-hole or like hare lip,* has been met with as the result of wounds of the eyelids, in which, by neglect, the edges have not been kept in apposition, but allowed to cicatrize separately. Such cases are to be treated, by making the edges of the fissure raw, and uniting them by suture.

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* The fissure like hare-lip has been called *coloboma*, or, since the name has been employed generically, *coloboma palpebræ*, the other species being *coloboma iridis* (p. 441). A congenital fissure of the eyelid (*congenital coloboma palpebræ*) has been met with.

The eyeball is sometimes wounded through the eyelid. In such penetrating wounds of the eyelid, with implication of the eyeball, adhesion of the former to the latter may take place. In treating such wounds, therefore, the possibility of this should always be kept in mind, and care taken to prevent it.

Injury of the nerve of the fifth pair in wounds of the eyebrow has been above referred to (p. 739).

3rd.—*Poisoned wounds.*

When the eyelids happen to be stung by wasps, bees, or the like, there is considerable swelling and irritation, sometimes severe erysipelatous inflammation of the part, ending in the formation of a small slough.

If the sting of the insect has been left in the wound, an attempt should be made to extract it. Whether this proves successful or not, the part is to be rubbed with olive oil, and covered with cloths wet with a fresh-made solution of the hydrochlorate of ammonia.

If there is any general disturbance of the system occasioned by the injury, a glass or two of wine may be taken, or a few drops of ammonia in sugared water occasionally.

Malignant pustule, which might be brought under the head of poisoned wounds, has been already treated of (p. 613).

4th.—*Burns and scalds.*

Scalds of the eyebrows and eyelids, in which the texture of the dermis is not injured, are of comparatively small consequence, except in so far as the conjunctiva may be implicated. Slight burns may be also unimportant in their effects, but when the burn is so severe that the dermis is injured, then there is great danger of such contraction taking place, in cicatrization, as to occasion lagophthalmos or ectropium. See above under those heads.

To oppose as much as possible the tendency to contraction during cicatrization, the eyelids must be kept closed, luxuriant granulation encouraged, and cicatrization retarded.

Another danger of burns, and this is also the principal danger from severe scalds, is, supposing the eyeball to have escaped, anchyloblepharon, when the borders of the eyelids have been rendered raw, and the patient allowed to lie with his eyes closed. See above (p. 668.)

When gunpowder is exploded against the eye, the injury is seldom confined to the eyebrow and eyelids. See above (p. 739.)

SECTION III.—INJURIES OF THE LACRYMAL ORGANS.

1st.—*Injuries of the lacrymal gland and ducts.*

While the upper mass of the lacrymal gland is, from its situation, well protected from injury, the ducts, together with the lower mass of the gland, may readily be implicated in a wound of the upper eyelid. Wound of the lower mass of the gland, together with some of the lacrymal ducts in Crampton's operation for entropium, is above referred to, p. 654, foot note. In a case of lacerated wound of the upper eyelid involving the ducts and lower mass of the gland, which came under my notice, sinuses formed, and the wound showed no disposition to heal.

In a case of gun-shot wound, related by Larry, the ball struck towards the superior external angle of the left orbit. Being cleft in two, one half took the direction of the temple, the other half lodged in the upper mass of the lacrymal gland, along with which, in a lacerated state, it was removed by enlarging the wound in the eyelids. The wound healed, the eye was saved, and continued to be sufficiently moistened.

2nd.—*Injuries of the derivative lacrymal organs.*

Foreign body in the punctum.—A loose eyelash sometimes gets into one of the puncta by one end, and by the other, which projects, irritates the lacrymal caruncle, as above mentioned (p. 688). The possibility of this accident should be kept in mind, and attention directed to the state of the puncta in any case of irritation at the inner canthus. Dr. Mackenzie, who has seen a number of such cases, mentions that in one of them, the patient himself detected the hair as the cause of irritation, but not recognising its unusual mode of implantation, he made it be cut short with a pair of scissors, but this only rendered the irritation greater. Demours relates a case in which a piece of a barley awn got introduced into the lacrymal point, one end projecting out to a small extent. The foreign body being discovered, the removal of it is an obvious and simple matter.

Injuries involving the lacrymal papillæ, puncta, and canalicules.—Wounds of these parts are not of common occurrence. The implicated canalicule had best be slit up towards the caruncle; whilst the edges of the wounded eyelid should be brought accurately together, and retained so by stitches, in order, if possible, to obtain union by the first intention.

Injury of the papillæ, puncta, and canalicules may be occasioned by burns, caustic, &c.

Injury of the lacrymal sac.—A simple penetrating wound of the lacrymal sac will heal if the lining membrane be healthy, but a fistulous opening is apt to remain if the lining membrane has not been in a healthy state originally, or if it has in consequence of the injury fallen into such a state. This is more apt to happen in consequence of laceration or contusion of the part, and that especially in scrofulous subjects.

Mr. Lawrence mentions his having seen three or four instances of the lacrymal sac being burst by a blow, with escape of air into the cellular tissue of the lids; the emphysematous swelling, which was considerable, but not extending beyond the palpebræ, disappeared spontaneously in a few days. Emphysema of the eyelids may also arise from wound of the frontal sinuses.

In injuries of the osseous walls of the nose, the nasal duct may be implicated, the bones being driven in and pressing on the duct. When such appears to be the case, it would be warrantable to open the sac by incision, and insert a style into the duct, in order to prevent its being obliterated by any encroachment of its fractured walls.

SECTION IV.—INJURIES OF THE ORBIT.

1st.—*Blows, &c., on the edge of the orbit.*

Such injuries are, as above stated, the cause sometimes of periorbitis, running into suppuration and disease of the bone; sometimes of orbital tumours; sometimes of concussion of the eyeball; sometimes of intracranial mischief.

2nd.—*Penetrating wounds of the orbit.*

Injury of the orbit from penetrating wounds is necessarily attended with external wound of the eyelids, &c., but this, it is to be remarked, may be very small.

The consequences of such injuries of the orbit may be:—

1. Swelling of the eyelids, protrusion of the conjunctiva, and exophthalmos, from effusion of blood into the orbit.
2. Inflammation of the orbital cellular tissue, especially if any portion of the wounding body has been left lodged in the orbit.
3. Injuries of the muscles and nerves of the orbit, sometimes dislocation of the eyeball (p. 754).

As the instrument inflicting a penetrating wound of the orbit may, by piercing the orbital plate of the frontal bone, wound the brain, accidents of this kind must always be regarded with great anxiety, and carefully watched and treated.

The importance of keeping in mind the possibility of a foreign body having penetrated and become lodged in the orbit, has been above (p. 94) insisted on.

If a foreign body has penetrated into and lodged in the orbit, it must be extracted as soon as possible. By its extraction the risk of inflammation will be diminished, and if the eyeball is at the same time dislocated, restoration of it to its proper position, in the manner above indicated (p. 754), will be possible.

Rest, and the antiphlogistic regimen, more or less strict, must not only be enjoined, but the case must be closely watched for some time in order that inflammation may at its onset be duly met.

GLOSSARY.

Abscission (from abscidere, *to cut off*), a cutting off. Applied to the removal of total staphyloma, &c.

Achromatopsia (α, priv., *χρῶμα, colour, ὤψ, the eye*), want of power to distinguish colours.

Aegilops (*αἰγίλωψ*, from *αἴξ, αἰγὸς, a goat, ὤψ, the eye*), a name given by the older surgeons to a sinuous ulcer at the inner corner of the eye, from its resemblance to the *larmier*, or infra-orbital glandular sac of goats and other ruminating animals.

Albugo (albus, *white*), an opacity of the cornea.

Amaurosis (*ἀμαύρωσις, obscuration*, from *ἀμαυρόω, to render obscure*), impairment or loss of vision from paralysis of the optic nervous apparatus.

Amblyopia (*ἀμβλύς, dull, ὤψ, the eye*), impaired vision from defective sensibility of the retina.

Ametropea (α, priv., *μέτρον, measure*, and *ὤψ, eye*), without measure in respect to the adjustment of the eye. The opposite of Emmetropia.

Amphiblestroiditis (*ἀμφιβληστροειδὴς, the retina*, from *ἀμφιβληστρον, a net*, and *εἴδος, form*), retinitis, or inflammation of the retina.

Anchilops (*ἀγχίλωψ*, from *ἄγχι, near*, and *ὤψ, the eye*), name given by the older surgeons to the abscess at the inner corner of the eye, ending in the sinuous ulcer which they called Aegilops.

Anchyloblepharon (*ἀγκύλος, crooked, βλέφαρον, eyelid*), cohesion of the eyelids to each other at their borders.

Asthenopy (α, priv., *σθένος, strength*, and *ὤψ, the eye*), weak-sightedness.

Astigmatism (α, priv., and *στίγμα, a point*), without focus.

Atresia (α, priv., *τιτράω, to perforate*), closure, or imperforation; applied to the pupil, &c.

Atrophy (*ἀτροφία, consumption*).

Blepharitis (*βλέφαρον, eyelid*), inflammation of the eyelids.

Blepharoblennorrhœa (*βλέφαρον, eyelid, βλέννα, mucus, ῥέω, to flow*), first stage of puro-mucous inflammation of the conjunctiva.

Blepharophthalmia (βλέφαρον, *eyelid*, ὀφθαλμὸς, *eye*), called also Blepharophthalmo-blennorrhœa, puro-mucous inflammation of the conjunctiva in its fully-formed state.

Blepharoplegia (βλέφαρον, *eyelid*, πληγὴ, *stroke or blow*), paralysis of the eyelid.

Blepharoptosis (βλέφαρον, *eyelid*, πτῶσις, *a falling down*), called also simply Ptosis, a falling down of the upper eyelid.

Blepharospasmus, (βλέφαρον, *eyelid*, σπασμὸς, *spasm*), spasm of the eyelid.

Brachymetropia (from βραχύς, *short*, μέτρον, *measure*, and ὤψ, *eye*), short measure in respect to the adjustment of the sight. Identical with Myopia.

Buphthalmos (βους, *ox*, ὀφθαλμὸς, *eye*), Oculus Bovinus, dropsical enlargement of the eye.

Canthus (κανθος, *the rim of a wheel*), angle of the eye.

Cataract (καταράκτης, from καταῤῥάσσω, *to throw down with violence, to break or disturb*), opacity of the lens or its capsule.

Catoptrics (κάτοπτρον, *a mirror*). The department of optics which treats of the reflection of light.—Catoptrical, of or belonging to the reflection of light.

Ceratitis (κέρας, *horn, cornea*), inflammation of the cornea.

Ceratocele (κέρας, *horn, cornea*, κήλη, *tumour*), hernia of the cornea.

Ceratome (κέρας, *cornea*, τομὴ, *section*), a knife for making an incision of the cornea.

Chalazion (χάλαξα, *grando or hailstone*), a small tumour of the eyelid.

Chemosis (χήμωσις, from χήμη, *a gaping*, from χαινο, *to gape;* or χύμοσις, from χυμὸς, *humour; or fluid*), elevation of the conjunctiva like a wall round the cornea, from exudation into the subjacent cellular tissue.

Choroiditis (choroid, from χόριον, *chorion, one of the membranes of the fœtus*, εἶδος, *likeness*), inflammation of the choroid.

Chromatopsy, or Chromopsy (χρῶμα, *colour*, ὄψις. *vision*), chromatic or coloured vision.

Chroopsy, or Chrupsy (χρόα, *colour*, ὄψις, *vision*), chromatic vision.

Cilia (celo, *to cover or conceal, because they cover and protect the eye*, or from cieo, *to move*), eyelashes.

Cirsophthalmia (κιρσὸς, *varix*, ὀφθαλμὸς, *the eye*), a varicose state of the bloodvessels of the eye.

Clavus (*the head of a nail*), a certain degree of prolapse of the iris, through an opening in the cornea; the prolapsed portion of the iris being pressed flat like the head of a nail.

Collyrium (κολλύριον, from κολλύρα, *a cake: bread sopped according to Scaliger, this being a common application to the eyes*), a medicine for the eyes.

Coloboma (*κολόβομα, mutilation*), applied to fissures of the eyelids and of the iris, congenital or traumatic.

Corectomia (*κόρη, pupil, ἔκ, out, τέμνω, to cut*), operation for artificial pupil by excision.

Coredialysis (*κόρη, pupil, διαλύω, to loosen*), operation for artificial pupil by separation.

Corelysis (*κόρη, pupil,* and *λύσω, I loosen*), an operation for detaching the adhesion of synechia posterior.

Coremorphosis (*κόρη, pupil, μόρφωσις, formation*), operation for artificial pupil in general.

Coreoncion (*κόρη, pupil, ὄγκος, hook*), hook invented for the operation for artificial pupil by separation.

Coreplastice (*κόρη, pupil, πλαστικὴ, the art of making images*), operation for artificial pupil in general.

Cornea (*cornu, horn*), the cornea is so called from its horny appearance.

Corotomia (*κόρη, pupil, τέμνω, to cut*), operation for artificial pupil by incision.

Curette (*French for a small spoon*), Daviel's spoon, an instrument used to assist the exit of the lens in the operation of extraction.

Dacryoadenitis (*δακρύω, to weep, ἀδὴν, gland*), inflammation of the lacrymal gland.

Dacryocystitis (*δακρύω, to weep, κυστις, sac*), inflammation of the lacrymal sac.

Dacryo-cysto-blennorrhœa (*δακρύω, to weep, κυστις, sac, βλέννα, mucus, ῥέω, to flow*), blennorrhœa of the lacrymal sac.

Dacryohæmorrhysis (*δακρύω, to weep, αἷμα, blood, ῥέω, to flow*), sanguineous lacrymation.

Dacryolites (*δακρύω, to weep, λίθος, a stone*), calculous concretions deposited in the lacrymal passages.

Dacryoma (*δακρύω, to weep*), stillicidium lacrymarum.

Diplopy (*διπλόος, double, ὤψ, vision*), double vision.

Distichiasis (*δὶς, twice, στίχος, a row*), a form of trichiasis in which the maldirected eyelashes form a second row, distinct from the others.

Distigmatism (*δὶς, twice, στίγμα, a point*), double focus.

Ectropium (*ἐκτροπιον,* from *ἐκ, out, τρέπω, to turn*), eversion of the eyelids.

Embolism (*ἔμβολον, a plug*), obstruction of the circulation in a part by a plug of lymph or matter in the artery.

Emmetropia (from *ἔμμετρος, measured,* and *ὤψ, eye*), full measure in respect to the adjustment of the sight.

Encanthis (*ἐν, in, κανθὸς, the corner of the eye*), enlargement of the lacrymal caruncle.

Entropium (*ἐν, in, τρέπο, to turn*), inversion of the eyelids.

Epicanthus (*επὶ, upon, κανθὸς, angle of the eye*), a congenital peculiarity of a fold of skin extending over the inner canthus.

Epiphora (επὶ, *upon*, φέρω, *to carry*), watery eye from excess of lacrymal secretion.

Exophthalmos and Exophthalmia (ἐξ, *out*, ὀφθαλμὸς, *eye*), protrusion of the eyeball. Exophthalmos is used when the eyeball is otherwise uninjured; exophthalmia, when, in addition to the protrusion, there is disorganization of the eyeball.

Gerontoxon (γερων, *old*, τόξον, *a bow*), arcus senilis.

Glaucoma (γλαυκὸς, *sea-green*), a greenish opaque appearance behind the pupil.

Glycerine (γλυκερὸς, *sweet*), a proximate principle of fats and oils, so named from its sweetness.

Grando (*hailstone*), a small tumour of the eyelid.

Gutta opaca, name given by the Arabians to cataract, as they supposed it an opaque drop in front of the lens.

Gutta serena (drop serene), name given by the Arabians to amaurosis, supposing it to depend on a clear drop fallen from the brain into the eye.

Haemophthalmos, Haemophthalmia (αἷμα, *blood*, ὀφθαλμὸς, *the eye*), sanguineous effusion into the eye.

Hemeralopia (ἥμερα, *day*, ὄψις, *vision*), night-blindness. It has been also employed to mean day-blindness (ἥμερα, *day*, α, priv. or αλαὸς, *blind*, ὄψὶς, *vision*).

Hemiopy (ἥμισυς, *half*, ὄψις, *vision*), a defective state of vision, in which one half of objects only is seen.

Hippus (ἵππος, *oculorum affectio assidue trementium*).

Hordeolum (hordeum, *barley*), stye.

Hyalitis, or Hyaloiditis (ὕαλος, *glass*), inflammation of the hyaloid membrane.

Hydrophthalmia, or Hydrophthalmos (ὕδωρ, *water*, ὀφθαλμὸς, *the eye*), dropsy of the eye.

Hyperkeratosis (ὑπὲρ, *above*, κεράς, *cornea*), conical cornea.

Hypermetropia (ὑπερμετρος, *beyond measure*, and ὤψ, *eye*), oversightedness. The opposite of Myopy.

Hypoaema (ὑπὸ, *under*, αἶμα, *blood*), blood in the anterior chamber.

Hypochyma (ὑπὸχυμα, or ὑπὸχυσις, from ὑπὸ, *under*, χύμα, *effusion*), cataract.

Hypogala (ὑπό, *under*, γάλα, *milk*), effusion of a milky-like matter in the anterior chamber.

Hypopyon (ὑπὸ, *under*, πύον, *pus*), pus in the anterior chamber.

Iriankistron (ἶρις, *iris*, ἄγκιστρον, *a fish-hook*), an instrument invented for performing the operation of artificial pupil by separation.

Iridauxesis (ἶρις, *iris*, αὔξησις, *growth*), thickening or growth of the iris from exudation into its substance.

Iridectomedialysis (ἶρις, *iris*, ἐκ, *out*, τέμνω, *to cut*, διάλυσις, *separation*), operation for artificial pupil by a combination of excision and separation.

Iridectomia (ἶρις, *iris*, ἐκ, *out*, τέμνω, *to cut*), operation for artificial pupil by excision.

Iridencleisis (ἶρις, *iris*, ἐν, *in*, and κλείω, *to close*), the strangulation of a prolapsed portion of the iris between the lips of an incision in the cornea in certain operations for artificial pupil.

Iridodesis (ἶρις, *iris*, and δέσις, *ligature*), ligature of the prolapsed iris.

Iridodialysis (ἶρις, *iris*, διάλυσις, *separation*), the operation for artificial pupil by separation.

Iridoncosis (ἶρις, *iris*, and ὄγκος, *tumour*), a name formerly proposed by Von Ammon for the same morbid state of the iris as that to which he has since given the name of Iridauxesis; but now applied to an abscess of the iris.

Iridoperiphakitis (ἶρις, *iris*, περὶ, *over*, φακος, *a lens or lentil*), inflammation of the uvea and anterior wall of capsule of the lens.

Iridorhesis (ἶρις, *iris*, and ῥήσσω, *I tear*), artificial pupil by laceration of the iris.

Iridoschisma (ἶρις, *iris*, σχίσμα, *fissure*), a fissure of the iris. See Coloboma.

Iridotomia (ἶρις, *iris*, τομὴ, *section*), the operation for artificial pupil by incision.

Keratitis (κέρας, *horn*, *cornea*), inflammation of the cornea.

Keratonyxis (κέρας, *cornea*. νύξις, *a puncture*), corneal puncturation in needle operations for cataract.

Korectomia. See Corectomia.

Koredialysis. See Coredialysis.

Koremorphosis. See Coremorphosis.

Koreplastice. See Coreplastice.

Korotomia. See Corotomia.

Kyklitis (κυκλος, *a circle*, ιτις, *affix denoting inflammation*), inflammation of the ciliary circle or body.

Lagophthalmos (λαγὸς, *a hare*, ὀφθαλμὸς, *the eye*), oculus leporinus, or hare's eye. Retraction or shortening of either eyelid.

Leucoma (λευκόω, *to whiten*, or λευκός, *white*), opacity of the cornea from a cicatrice.

Lippitudo (lippus, *blear eyed*), blear eye.

Luscitas (luscus, *blind of one eye*), fixed misdirection of the eye.

Madarosis (μαδάρωσις, from μαδὸς, *bald*), a falling out of the eyelashes.

Marmaryge (μαρμαρυγὴ, *splendour*), an appearance of sparks or coruscations before the eyes.

Metamorphopsy (μεταμορφόω, *to transform*, ὄψις, *vision*), distorted appearance of objects.

Microphthalmos (μικρὸς, *small*, ὀφθαλμὸς, *the eye*), smallness of the eye from imperfect development.

Micropy (μικρὸς, *small*, ὄψις, *vision*), a state of vision in which objects appear smaller than natural.

MILIUM (*a millet seed*), a small white tumour of the eyelids o their neighbourhood.

MONOBLEPSIS (*μόνος*, *single*, *βλέψις*, *view*), state in which visio is distinct only when one eye is used.

MUCOCELE (*μυξα*, *mucus*, *κήλὴ*, *a tumour*), dropsy of the lacrymal sac.

MUSCÆ VOLITANTES (musca, *a fly*, volito, *to fly about*), the appearance of greyish motes before the eyes.

MYDRIASIS (*ἀμυδρὸς*, *obscure*, or *μυδάω*, *to abound in moisture* because it was supposed to be owing to redundant moisture), preternatural dilatation of the pupil.

MYOCEPHALON (*μυῖα*, *a fly*, *κεφαλὴ*, *the head*), a small protrusion of the iris, like a fly's head, through an ulcerated opening i the cornea.

MYODESOPSIA (*μυῖα*, *a fly*, *ὄψις*, *vision*), muscæ volitantes.

MYOPY (*μύω*, *to shut*, *ὤψ*, *the eye*), nearsightedness.

MYOSIS (*μύω*, *to shut*), preternatural contraction of the pupil.

MYOTOMY (*μῦς*, *a muscle*, *τέμνω*, *to cut*), section of muscles. Ocular myotomy, section of muscles in strabismus.

NYCTALOPIA (*νὺξ*, *night*, *ὄψις*, *vision*), day-blindness. Employed also for night-blindness (*νὺξ*, *α*, priv. or *αλαος*, *blind*, *ὄψις*, *vision*).

NYSTAGMUS (*νυσταγμὸς*, *sleep*), oscillation of the eyeball.

OCULUS BOVINUS (bos, bovis, *an ox*), ox-eye. See BUPHTHALMOS.

OCULUS LEPORINUS (lepus, leporis, *a hare*), hare's-eye. See LAGOPHTHALMOS.

ONYX (*ὄνυξ*, *a nail*), deposition of matter in the substance of the cornea.

OPHTHALMIA (*οφθαλμὸς*, *the eye*), a general name for inflammation of the eye.

OPHTHALMIA NEONATORUM (*νέος*, *young*), purulent ophthalmia of new-born infants.

OPHTHALMITIS, inflammation of the whole eyeball.

OPHTHALMODYNIA (*ὀφθαλμὸς*, *eye*, *ὀδύνη*, *pain*), pain in the eye.

OPHTHALMOLOGY (*ὀφθαλμὸς*, *eye*, *λόγος*, *a discourse*), the science of ophthalmic medicine and surgery.

OPHTHALMOPLEGIA (*ὀφθαλμὸς*, *eye*, *πληγὴ*, *a blow or stroke*), paralysis of the muscles of the eyeball.

OPHTHALMOPTOSIS (*ὀφθαλμὸς*, *eye*, *πτῶσἰs*, *a falling down*, from *πίπτω*, *to fall*), the protrusion of the eyeball, resulting from paralysis of its muscles.

OPHTHALMOSCOPE (*ὀφθαλμὸς*, *eye*, *σκοπέω*, *to examine*), the instrument for exploring the interior of the eye.

OPHTHALMOSCOPY (*ὀφθαλμὸς*, *eye*, *σκοπιὰ*, *a looking out*), exploration of the eye.

OXYOPIA (*ὀξὺs*, *sharp*, *ὤψ*, *the eye*), preternatural acuteness of vision.

PACHEABLEPHARA, PACHYTES (*παχύτης*, *thickness*, from *παχὺς*, *thick* *βλέφαρον*, *eyelid*), enlargement and thickening of the eyelid.

Palpebræ (a palpitando, *from their frequent motion*), the eyelids.

Pannus (pannus, *cloth*), a thickened and vascular state of the conjunctiva corneæ.

Paracentesis (παρὰ and κεντέω, *I pierce*).

Paracentesis corneæ, puncture of the cornea.

Paresis (πάρεσις, εως, *relaxation*), applied to muscular action.

Periorbita (περὶ, *over*), the periosteum of the orbit.

Phantasms (φάντασμα, ατος, *a spectre*).

Phlyctenula (φλὺκταινα, *a vesicle*, from φλύζω, *to gush forth*), vesicle filled with a watery fluid.

Phosphènes (from φῶs, *light*, and φαίνω, *I make appear*), luminous spectra produced by pressure.

Photophobia (φῶs, *light*, φοβέω, *to dread*), intolerance of light.

Photopsia (φῶs, *light*, ὄψις, *vision*), subjective appearance of light before the eyes.

Phtheiriasis (φθειρίασις, *morbus pedicularis*, from φθεὶρ, *a louse*), pediculi among the eyelashes and hairs of the eyebrows.

Pinguecula (pinguis, *fat*), a small tumour on the white of the eye near the edge of the cornea, apparently but not really adipose.

Pladarotes (πλαδαρὸs, *flaccid*), thickening of the palpebral conjunctiva.

Polyopia (from πολὺs, *many*, ὤψ, *vision*), manifold vision.

Presbyopy (πρέσβυs, *old*, ὤψ, *the eye*), old-sightedness.

Proptosis (πρὸ, *before*, πτῶσις, *a falling down*, from πίπτω, *to fall*). See Ophthalmoptosis.

Psorophthalmia (ψώρα, *scabies*, ὀφθαλμὸs, *the eye*), ophthalmia tarsi.

Pterygium (πτερὸν, *a wing*, πτερύγιον, *a small wing*), thickened and vascular state of a portion of the conjunctiva, of a triangular shape, the apex encroaching more or less on the cornea.

Ptilosis (πτίλωσις, *bald*), falling out of the cilia. See Madarosis.

Ptosis (πτῶσίs, *a falling down*, from πίπτω, *to fall*), falling down of the upper eyelid.

Pupil (*pupilla*), the aperture in the iris.

Retinitis (rete, *a net*), inflammation of the retina.

Rhexis, or Rhegma Oculi (ῥῆξις and ῥηγμα, *a rupture*), rupture of the eyeball.

Rhytidosis (ῥυτίδωσις, *a wrinkling*, from ῥυτιδόω, *to wrinkle*), collapsed or shrunk state of the cornea.

Sclerotitis (σκλερὸs, *hard*), inflammation of the sclerotica.

Scotomata (σκότωμα, *dizziness*, from σκυτόω, *to darken*), dark spots seen before the eyes: see Muscæ Volitantes.

Staphyloma (σταφυλὴ, *a grape*), a projection of some part of the eyeball, generally of the cornea and iris, or sclerotica and choroid.

Staphyloma Racemosum (racemus, *a bunch of grapes*), staphyloma is so called when there is an appearance of several projections.

STENOCHORIA (στενοχωρία, *narrowness of space*, from στενὸς, *narrow*, χῶρος, *space*), a contraction; applied to the derivative lacrymal passages.

STENOPAEIC (from στενός, *narrow*, and ὀπή, *a peep-hole*).

STEREOSCOPE (στερεὸς, *solid*, and σκοπέω, *I look at*).

STILLICIDIUM (stillo, *to drop*, cado, *to fall*), dropping of tears from the eye, in consequence of obstruction of the derivative lacrymal passages.

STRABISMUS (στραβίζω, *to squint*, from στραβὸς, *twisted*), squinting.

SYMBLEPHARON (σὺν, *together*, βλέφαρον, *eyelid*), adhesion of the eyelids to the eyeball.

SYNCHYSIS (σύγχυσις, *mixture*, from σὺν, *together*, and χύω, *to pour*), dissolution of the vitreous body.

SYNECHIA (συνέχεια, *continuity*, from συνέχω, *to keep together*), adhesion of the iris to the cornea or capsule of the lens; in the former case it is distinguished as anterior synechia, in the latter as posterior synechia.

SYNIZESIS (συνίζησις, *a falling together*, from συνίζω, *to sit together*), closure of the pupil.

TARAXIS (τάραξις, *disturbance*, from ταράσσω, *to disturb*), slight external ophthalmia.

TARSORAPHIA (ταρσος, *tarsus*, ῥαφή, *a suture*), suture of the tarsal margins in ectropium of the external angle.

TRACHOMA (τραχυμα, *roughness*, τραχόω, *to make rough*), granular conjunctiva.

TRICHIASIS (θρίξ, *a hair*), inversion of the eyelashes.

TRICHOSIS (θρίξ, *a hair*), TRICHOSIS BULBI, a small tumour on the front of the eyeball, with hair growing from it.

TYLOSIS (τύλος, *callosity*), thickening and induration of the borders of the eyelids.

XEROMA, XEROPHTHALMIA, XEROSIS (ξηρὸς, *dry*), dryness of the eye, of which there are two kinds, viz., conjunctival and lacrymal.

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